GROUND WATER
IN SOUTHWESTERN ONTARIO
- A REPLENISHABLE RESOURCE -

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GROUND WATER IN SOUTHWESTERN ONTARIO

- A REPLENISHABLE RESOURCE -

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GROUND WATER IN SOUTHWESTERN ONTARIO

- A REPLENISHABLE RESOURCE -

A study and assessment of ground water in Southwestern Ontario.

- PREFACE -

The initial work on this investigation of ground waters was carried out by Earle G. Maxwell, retired Superintendent of Water Works at Simcoe, Ontario. His untimely death before the work could be completed made it necessary to adopt other measures.

The remaining field work and the preparation of the report was carried out by Dr. Albert E. Berry, in conjunction with Dr. James A. Vance, and Mr. T. L. McManamna, who acted as consultants:

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President R. T. D. Birchall.

This publication is a memorial to the late Earle G. Maxwell, for many years a most valued public official in the water works field.

Price: $2.00

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" A person will work with his hands in order to live, but he will put his heart into his work when he is striving toward excellence. Having the desire to achieve excellence, the next thing to do is to act toward winning it."


Georgian Bay
Lake Huron
OWEN SOUND
GREY
BRUCE
HURON
PERTH
OXFORD
MIDDLESEX
LONDON
SARNIA
LAMBTON
ELGIN
KENT
Lake Erie
WINDSOR
ESSEX

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

The humidity was high, the clouds hung low. It was a typical, warm evening of early summer. Raindrops beat against my window panes as we watch the rain trickle down the glass and start its long journey to nourish the earth and to carry out its many tasks. The return journey to the sky is less dramatic. This is an eternal process. The earth continually cries for and is fed the water of life. How wonderful is the cycle!

NATURE AT WORK

Our insatiable environmental curiosity is certain to be aroused by nature at work. How does this cycle function to serve the multitudinous needs of man and the earth? Will these small drops on the glass find their way directly to the nearest river or lake, or will they seep into the great underground storage basin? How much foreign matter will be picked up and carried along enroute? How many needs will be satisfied in that journey? What is man doing to change the course of nature? How does nature conserve her water resources that they may be used to greatest advantage? All these many conjectures are answered by nature in due course. Man must learn.

Nature makes water available from two sources to serve the needs of the earth and all thereon. One is at the surface in rivers, lakes, and ponds, and the other is ground water hidden either near the surface or deeper in the subterranean reservoirs. Man must seek. It has always been this way.

Water, as the greatest gift of nature, has always been a replenishable resource. It is ever seeking to search out and follow along the hydrologic cycle from cloud or atmosphere to earth and back again. The ocean becomes a

resting place in that journey. Man's needs and all his works must be satisfied from this cycle. Humanity has learned that this is accomplished by various ways and devices as evaporation, precipitation, storage and seepage. The earth and all creatures on it must be moistened to sustain growth. Thus, man and nature jointly share in the need for water and in the means for securing it.

It has long been known that man needs to understand and cooperate fully with nature. What lessons can he learn if he is willing to open the book of records and observe the pages of time. Sig Olson, the naturalist and author says "During the past century more hidden mysteries of nature have been uncovered than in the previous 5,000 years".

Let us start with the history of water use and abuse. What was the quality or condition of the water and how effective was the water cycle in this country and this Province of Ontario some many years ago? Nature alone was in charge then. Some would urge that we move back our activities and cancel any impact on the environment to the point where man will not in any way despoil or alter the earth's water resources, even temporarily. Beneficient as this might seem, it is impractical. On the contrary, can we reach the stage where man's activities and nature can exist jointly, and move forward harmoniously? Both man and nature can exercise in ther activities a good deal of flexibility. Much is waiting to be accomplished through cooperation.

There is a constant need for great quantities of water. Man scans the clouds and puts confidence in these as indicators of plenty, excess, or scarcity of moisture. The beautiful words in Shelley's poem about the "Cloud" are appropriate here and closely tied to water supply;

"I am the daughter of earth and water,
And the nursling of the sky;
I pass through the pores of the oceans and shores;
I change but I cannot die."

As the population increases, wider activities follow, and water must be supplied on a priority basis. The quantity needed in most places is steadily rising. Some are wont to say that all the water or nearly all is already used and future demands will not be met. Can this fear be due to defilement of the water or to lack of continuous quantative flow? If there is sufficient water in the regular cycle, then only protection of quality and sufficient storage should be needed. Conservation and reuse become dominant. While the world's water is constant, the supply is not always in the place where it is needed.

As this century emerged the Village pump, the farm well, and the rain water cistern were conspicuous in Ontario as supply works. The early settlers here, like elsewhere, chose to stay close to water routes. These provided not only a primary need of transportation but also a supply of water for domestic and agricultural uses, not overlooking the convenient practice of waste disposal.

As populations apread inland, the dug or drilled well came to the rescue. Knowledge of well construction increased. It was accompanied by information on how to find an adequate supply of potable water, and then to protect it.

It was a slow transition from those early works to modern drilled deep wells and purification plants which had to be built to restore defiled surface waters. This growth in knowledge on where to find water became an intense skill. The driller learned through is training and experience where to obtain suitable water in the interstices of the earth and rocks and in the immense underground storage basins.

These early water programs and the transition to modern efficiencies have brought us to a serious question. How far have we really gone in developing and utilizing our sources of water? How much water is there underground in any specific area? How can it be measured and how can it be conserved? What is its quality?

Conservation of a country's natural resources calls for priority encased in a national objective. This is especially applicable to water resources. The objective in this is not merely to avoid waste, but probably even more important, to protect its quality, storage, distribution, and availability. So long as the population was small and scattered, this need was less apparent. That situation no longer holds true in Southwestern Ontario. It now behooves all to take an active part in water conservation measures.

Surface waters are sufficiently visible to command attention and public support. They can be measured readily and steps taken to conserve them for best use. The more complex problem in conservation is met with ground water.

THE UNDERGROUND BASIN

We may ask what is being done to the apparently vast amount of water in the underground reservoir.

Is it being diminished, polluted, or otherwise altered from the way nature intended? Are we conserving our bank deposit of ground water or overdrawing from that account? Also, are we making full use of this great and essential resource?

This supply is nationally important. It has been tapped in many places for municipal, domestic, agricultural, recreational, and industrial uses. But, how much do we know about the amount and quality of water that can be

abstracted from that underground reservoir continuously and under varying unfavourable conditions? Will bulk water be shifted from place to place - from where it is needed to another where it may not serve a critical purpose? The problem is a complex one which needs concentrated attention.

THE AREA OF STUDY

YOU HAVE IT, PROTECT IT.

This area study of water supply and its conservation is directed primarily to ground water. It by-passes surface supplies except for general background information and a comparison with the characteristics of ground waters. Both are widely used by municipalities and industries in Southwestern Ontario.

It is a well-worn cliche that "water is where you find it". But the problem in most instances is to obtain a supply suitable in quantity and quality within an economical distance from where it is to be used.

COUNTY ACREAGE - POPULATION

SOUTHWESTERN ONTARIO

County	Total Acreage	Population
Bruce	973,830.4	52,313
Elgin	464,518.4	68,232
Essex	460,108.8	310,343
Grey	1,113,056	69,182
Huron	840,832	54,671
Kent	613,107.2	103,229
Lambton	699,539.2	114,166
Middlesex	812,518.4	304,824
Oxford	6,035.2	83,303
Perth	541,216	64,984
TOTAL	6,524,761.6	1,225,246

The foregoing statistics for the Counties in Southwestern Ontario are of interest in relation to water demands. The total population of nearly one and one-quarter millions is closely allied to the figures for the cities of Windsor and London. Industrial centres are expected to have relatively high assessments and corresponding demands for water. Surface supplies are in use for both of these cities.

WHAT OF THE FUTURE?

As we continually become more conscious of the dwindling of our natural resources, we focus attention, with fear, on whether there will be enough water to satisfy the demands of the future. How effective will be the underground reservoir? What will be the qualities of these ground waters? Will they change? How much of the geological formations has been and is being removed by the rainwater as it percolates down from the surface into that reservoir? What effect does this have on the quality of the ground water? How much water can we draw from this underground water bank in lean periods? It is those periods that cause so much confusion and anxiety.

A GOOD CONSERVATION POLICY

An underground water reservoir may be likened to a working bank in which withdrawals are balanced against deposits. Conservation must be recognized as the best use of all available supplies. This is true of any renewable resource. It is not merely a question of withholding from active use. Any bank deposit needs to be put to use and earn interest.

It will be obvious that water that is not used serves no laudable function. It needs to be withdrawn from the reservoir or bank and put to use in the water cycle. This is the only way it can serve the earth to advantage. A deposit never put to use brings no return.

Southwestern Ontario is effectively covered by Conservation authorities. They are expected to encourage good conservation. One of these measures must be the development and use of groundwater.

THE OBJECTIVE OF THE PROJECT

The objective in this study project is to collect and examine available data on the ground water resources in the area - the Southwestern part of the Province of Ontario, and to determine the effectiveness of the use being made of these waters. This area has many characteristics which are attractive in such an examination.

While the project focuses attention on the ground water rather than surface supplies, there can be some useful comparisons between the two, especially in quality and availability. Conservation of the ground water supplies will be given priority. This will be in the broad aspect of conservation, i.e. that which must mean the wise use of this resource and the prevention of its depletion, deterioration or destruction.

The present is timely for such examination. There is increasing concern over water supplies here and elsewhere. The country is growing in population, and greater demands are simultaneously arising from industry. Many new sources of pollution are arising. Agriculture has long been well aware of the importance of sufficient water of good quality. Much of that supply must come from underground. Southwestern Ontario is one of the most favoured sections for industrial expansion. If there is in this area of the Province a great reservoir of unused water it should be possible and imperative to utilize it to advantage in the development and welfare of the Province at large.

It is desirable, at the outset, to include some background information

on ground water, where it is generally to be found, how it is to be procured, and especially how it is to be managed. A comparison of this information with the data found in the field will be of value. The science associated with ground water must operate in an invisible physical sector, but marked strides have been made in that part of the science which permits efficient development and management of this resource.

Ground water is a dynamic renewable resource. But there is need for an integrated management of all water resources, not alone surface water or ground water. The need for quality water increases, and the most effective measures to meet this are essential. A program of complete and overall management for all functions of our water resources, often discussed, needs concentrated action and follow through.

THE HYDROLOGIC CYCLE

Knowledge of what is significant in ground water management is a first step in its utilization and control. The hydrologic cycle concerns one of the physical factors that control the behaviour and occurrence of ground water. Knowledge of how this operates is fundamental to understanding the process in locating and developing ground water supplies. The interpretation of particular conditions within the geographic area concerned must be sought.

The occurrence and behaviour of ground water within the hydrologic cycle will be influenced by local conditions. What are some of the features of this cycle?

The cycle is a natural circulatory system on a gigantic scale, continuously on the move. It operates in and on the land, lakes, rivers, and oceans, through vegetation and in the atmosphere surrounding the earth.

The cycle is well described in the Ground Water Manual of the American Water Works Association.

"The oceans and lakes, which cover three-fourths of the earth's surface, are a logical point of beginning for a discussion of the cycle. Water is evaporated from these surfaces, rises into the atmosphere, forms clouds, moves with the winds, eventually is sufficiently cooled to condense, and falls back to the earth as dew, rain, sleet, hail or snow. Some of this precipitation vaporizes as it falls; more wets the foliage and surface of the ground, from which it may again evaporate. A portion of the excess runs off over the surface of the ground into streams and, in time, back to the oceans. The remainder soaks into the ground. This last portion and the factors that control its storage and movement are those of most concern here."

It is difficult to follow precisely the course of the water that penetrates below the surface of the ground. It is subjected to other forces of nature which govern its movements.

The term "ground water" should not be applied to all water that penetrates below the surface of the ground. In a natural situation, the water is first absorbed by the soils and held by molecular attraction around each individual particle. This moisture then is available to plants and to the circulation of air for evaporation. When this molecular attraction is satisfied then gravity brings the excess water farther below the ground surface to an intermediate area. Here once again, molecular attraction must be satisfied. The soil and this intermediate area are called the "zone of aeration". Below this is the "zone of saturation" where water fills all the available pore spaces. Another factor is also involved. Between the zone of saturation and the intermediate area there is a capillary fringe where water is held in the pore spaces by capillary action against the force of

gravity.

It is in the zone of saturation that water is available to supply wells, feed springs, and to flow into surface streams. It is this water that rightly is called "ground water". The top of this zone of saturation is known as the water table. Variations in the elevation of this may be expected.

We are interested in determining the amount of water in the zone of saturation. This is influenced by such factors as changes in elevation of the water table, consistency of the earth's materials, average annual precipitation, and stream development.

The intermediate area water is beyond reach of plant roots. It cannot be considered as soil moisture, The thickness of this area is influenced by drainage from the zone of saturation and by soil development It is reported to vary between 0 and 300 feet or more.

In the conservation of water we are concerned primarily with the zone of saturation. How was this formed and what are the forces acting on it? Water is the most important factor in the breakdown and movement of earth materials. Its carrying capacity depends on its velocity of movement. The result of this transportation is the deposition of sedimentary materials in layers of fairly uniform grain sizes. Some common sediments are sand, gravels, clays, sandstones and shales.

Porosity becomes an important result of the sorting by nature of these earth materials. This is the volume of the pore spaces in relation to the total formations, resulting from fracturing and solution by water. The extent of the porosity is naturally significant in calculating the yield from a well. The A.W.W.A. Manual states that porosities greater than 40 percent are rare. In general, a porosity of 20 percent or greater is large, while between 5 and

20 percent is medium, and less than 5 is small. Ground water may increase the porosity of limestone by dissolving the rock.

A formation must be porous in order to hold water. The specific yield is that amount of water given up by drainage. A portion is held by molecular forces. It is the former which is most important in ground water development.

The geologist is also involved with permeability of the formation, i.e. the ability of the area to allow the movement of water within itself. It is the rate at which water will flow through the aquifer under defined conditions.

A useful aquifer, or zone of saturation, must yield water in usable quantities. Two kinds of aquifers may be noted; a water-table aquifer and an artesian aquifer. The former is in contact with the soil atmosphere and receives most of its water replenishment by local vertical percolation. The latter type is under presure, and the water will rise in a well to an elevation above the top of the aquifer. These wells are common. In some, the water flows above the surface of the ground.

Another unit of measurement is involved for artesian aquifers. The coefficient of storage represents the storage property of the aquifer. Technically defined, it is the quantity of water yielded by a column of the aquifer with a base of one square foot and equal in height to the aquifer thickness when the water level in a tightly cased well tapping that aquifer declines one foot. The usual values of coefficients for artesian aquifers is given as 0.005 and 0.0005, and for water-table aquifers between 0.3 and 0.03.

The foregoing terms and figures are used by the well water geologist to interpret the local conditions and to estimate the yield of a well.

The use of land areas, as previously pointed out, has a distinct bearing on the continued yield of a well. The aquifer must be kept recharged. The runoff from a forested or natural area is quite different from the runoff of a developed area in an urban centre. The latter takes the water from pavements and roofs and quickly carries it away without much opportunity for soaking into the aquifer. Where feasible, care needs to be exercised to recharge. Means should be sought to maintain this.

The foregoing principles are to be recognized in the behaviour and management of ground water. How are these being applied in Southwestern Ontario? Are we developing and conserving, through good practices, the ground water of this area? Quality and quantity must be involved.

GEOLOGICAL AND RELATED CONDITIONS

An Age Old Wonder

A wide variation may be expected in the geological formations in which the wells are developed. This has a direct effect on the quantity and quality of the water. One clear example of this is the hardness of the water, a substance important in assessing water use potential.

Ground water Probability Maps have been prepared for some of the counties by the Ministry of Environment (formerly done by Ontario Water Resources Commission). These maps are based on a number of sources of information. They give a general indication of the chances for securing water from wells in these section, and the amount of water likely to be found.

The legend used for these maps shows four classes of wells: one where only a small amount of water is likely to be secured - i.e. difficult conditions; the second, where relatively small amounts are likely - usually sufficinet for domestic and stock purposes: a third, where the supplies are generally plen-

tiful for domestic and stock use and for small industrial and most commercial purposes but poor for irrigation; the fourth, suitable for most irrigation and many municipal uses.

An examination of these maps, where available, can be an aid for the driller and the owner. This also makes it possible to compare the potentials of the different counties and the areas in each county.

Reference is frequently made in the literature to the Precambrian or Canadian Shield. It is defined as north of a line drawn from Midland to Kingston and from Brockville to Pembroke. In this, the ground surface rises to a height-of-land north of Lake Superior, which extends in a general east-west direction. The elevation of this height-of-land is from 1000 to 2000 feet above sea level. The maximum elevation is just north east of Lake Superior.

The area south of the Precambrian Shield is known as the St. Lawrence Lowlands. This can be further subdivided into the Ontario Lowland and the Ontario Upland. The Ontario Lowland extends from the eastern counties of Prescott and Glengarry westward to the Niagara escarpment. A maximum elevation of 1000 feet is reached in the hilly interlobate moraine area where it meets the escarpment. This Niagara escarpment marks the boundary between the Ontario Lowland and the Ontario Upland. Much attention has been given in recent years to the escarpment. Its form is due to the bedrock of dense white-weathering dolomite underlain by softer shales and dolomites. The land surface dips regionally to the west and south away from the escarpment and towards Lake Huron and Lake Erie. The highest elevation of the Upland is in Dufferin and Grey counties where heights of between 1700 and 1800 feet above sea level are found in several places.

It is to be noted that over all Ontario a variety of glacial forms, such as recessional moraines, kames, deltas, and drumlins contribute to the variations in relief within the main physiographic regions.

The ground water study is concerned with these geological areas. They must influence the ground water supply and quality.

Other factors than geological, but related to it, affect the supply of ground water. Ontario is, in general, well drained. The total area of the Province is 412,582 square miles, of which 17 percent is fresh water lakes and rivers, most of these being in the Precambrian Shield. Most of the topography of the area is suitable for good drainage. The major drainage outlet, and of great importance to the province, is the Great Lakes - St. Lawrence River System.

Related also to this is the climate of the area. It largely determines the hydrologic characteristics. When the climatic factors of precipitation, temperature, sunshine and wind are observed over a long period, these provide a good background for assumption or forecast of future climatic and hydrologic conditions.

The wide use of gauging stations for climatic conditions has existed for many years. The average rainfall data are conspicuous in this program.

Further information on the geologic and related factors is provided for each county in the Appendices.

BASIC WATER QUALITY

Analyses are given, wherever available, for the ground water supplying the public systems.

A comparison may also be made with local surface water analyses for those used in public systems. These can be interpreted in relation to quality

objectives set by Canada and Ontario.

Man has had a long struggle to obtain and maintain suitable quality in water supplies. Water borne epidemics, so prevalent at the beginning of this century, are rarely encountered now. Raw water control measures, as well as effective treatment of public supplies have been called to overcome these dangers. The appropriate formation and facilities are available. It is for the effective use of these that man must always be alerted.

In recent years a change in approach to water problems has come about. The earlier years, when public health protection was so demanding, might be likened to a microbiological time in which safety against water borne organisms was the main point of attack. This has been widened in public attention to a microchemical period.

In this latter, the efforts of the administrator have to be directed to detection and control of microchemical contaminants. The adverse effects of these may be apparent only after lengthy use or consumption. In recent years, and as a result of research, much public attention has been drawn to the possible danger of some of these substances while present in the water in minute quantities only. The effects of long time use have also been studied.

Accordingly, today we must think not only of the biological side of pollutants but also the reaction of physical and chemical substances. The latter may be especially significant in ground water supplies. As the rainfall passes through the earth and rocks to the underground reservoirs will these contaminants be filtered out or retained in the earth, or will they be increased by the filter media as the water passes? This is important.

This microchemical factor, even though not recognized years ago as a potential risk, may now be regarded as such. Some wastes or foreign substances may be cumulative in the human body and in aquatic life to dangerous limits. Here, substances may be dissolved from the earth and rocks and carried along, probably only in minute quantities. If the sustained use of these in drinking water can be shown to have an adverse effect on the consumer then great care must be exercised in the selection of well sites and in the prevention of pollution of the earth's surface. This is a challenge to the researcher and to the administrator.

WATER USE

You Have It, Use It

Water has always served a variety of purposes. Those uses most commonly referred to are: domestic consumption, industrial supplies, recreation, agriculture, transportation, power, and air conditioning. For some of these the quality or contents is much more important than for others. This will be affected by the formations through which the water passes, and of course, by natural and man-made pollution.

The first step in the water problem for any area or community must be the location of an adequate quantity. Will this be satisfied by a surface supply or by ground water? In any event, a study will be needed to satisfy this requirement. The total quantity of water needed must include the rate of consumption. This is a commodity which must meet widely varying demands. Reservoir capacities suitable for these conditions are essential, either natural or man-made. They may be on the surface or under ground.

Some conception of the water use in parts of Canada may be seen in the tabulation provided herewith. These figures are deficient in that the rates of consumption are not included.

In recent years much attention has been directed to the detection of viruses in water. How serious may these organisms be, and how difficult is it to remove them from drinking water supplies?

Messrs Shaffer, Meierer, and McGee, writing in the October 1977 issue of the Journal of the American Water Works Association have this to say: -

> "Since each water system presents different problems in the monitoring for viruses, no single standard method has been found yet that is applicable in all cases - additionally, development programs are continuing in many laboratories to obtain the ultimate protocal for use in all waters for all viruses. Statistically it would be expected that with the present state of most wastewater processing, viruses would be present.
>
> The state of the art of virus detection is progressing to a point that investigators are able to determine extremely small numbers of viruses in large volumes of water (5 viruses in 500 gallons). Scientists now are able to learn the extent of an already existing pollution hazard."

From time to time, the water consumer is agitated by the presence of macroinvertebrates. These are defined as the larger invertebrates visible to the naked eye and retained by the U.S. Standard No. 30 sieve. They are generally botton-dwelling organisms and are made up largely of insects, crustaceans, annelids, roundworms, flatworms and mollusks.

Certain macroinvertebrates can be characterized as water-pollution indicators. These organisms, thus are a useful tool in the detection of environmental changes as the introduction of pollutants.

Accordingly, the detection of water quality and the prevention

of pollution are highly important in ground water development. Laboratory facilities, both in the field and at headquarters, are essential. This procedure is well expressed in the text of Walton on - "Ground Water Resource Evaluation", p. 439, thus:

> "In ground water resource evaluation, the quality of groundwater is of nearly equal importance to quantity. The chemical, physical and bacterial characteristics of groundwater determine its usefulness for municipal, commercial, industrial, agricultural and domestic water supplies. Development provides opportunities for pollution of groundwater and consideration must be given to the protection of quality. The study of groundwater quality involves a description of the occurrence of the various constituents in groundwater and the relation of these constituents to water use. In addition, groundwater quality data give important clues to the geologic history of rocks and indications of groundwater recharge, discharge, movement, and storage."

NOTE:

The rated capacities of the wells shown in the appendices are the figures supplied by the drillers to the Province.

WATER WORKS STATISTICS

The growth in municipal water works has been a steady one. It took some time in the previous century to get these programs under way. By the year 1850 there were only 3 public systems in operation - St. John, N. B. in 1837; Toronto, Ontario 1841 and Halifax, Nova Scotia 1848. By 1860 the total had risen to 6, and by 1880 the number increased to 30. The growth curve went up by 1890 to 105 and to 235 by 1900. From that time forward the number of systems rose sharply.

It is not clear in the records of these early systems whether use was made of ground water sources or of surface supplies. The first ones were all surface supplies as might be expected. Municipalities situated on large bodies of water took advantage of these navigable courses for transportation, water supplies, and waste disposal.

Recognition of the spread of typhoid fever through drinking water brought programs of treatment and selection of the supply from wells, protected sources, and treatment facilities. The processing of surface waters has gone through long programs, both to ensure safety and to provide the consumer with water of best overall quality.

The following statistics, compiled by the Ontario Ministry of the Environment, on water use or public supply systems are of interest:

Public water works systems in Ontario	450
Public water works systems in Southwestern Ontario	112
Public water works systems in Ontario supplied by ground water. . .	218
Public water works systems in Southwestern Ontario supplied by ground water. . .	57

The summary of the public systems for Ontario and the Southwestern Region, according to source and treatment are:

TYPE	Ontario	Southwestern Region
GROUND WATER		
(a) No treatment	153	41
(b) Physical treatement	24	5
(c) Chemical treatment	34	10
(d) Physical & Chemical treat.	7	1
SURFACE SOURCE		
(a) No treatment	74	5
(b) Physical treatment	21	5
(c) Chemical treatment	3	1
(d) Physical & Chemical treat.	94	23
AREA SCHEME SOURCE	40	21
Total Ministry Operated Works	85	22
Total Municipally Operated Works	365	90
Total Works	450	112

EQUALIZED ASSESSMENTS IN COUNTIES

From Ontario Government Statistics on

County equalized assessments

1)	Bruce County	$383,657,000
2)	Elgin County	593,529,000
3)	Essex County	3,063,078,000
4)	Grey County	580,051,000
5)	Huron County	382,893,000
6)	Kent County	864,644,000
7)	Lambton County	1,184,604,000
8)	Middlesex County	2,547,316,000
9)	Oxford County	758,225,000
10)	Perth County	499,180,000
	Total	$10,857,177,000

A review of the total assessments of the counties gives some indication of the likely need for water. The high figures are likely the result of high populations, and/or high industrial developments. Both are large water consumers. These figures may also relate to whether the source is ground

water or surface supplies.

SOURCES OF SUPPLY for Public Water Works Systems by Counties

		Total	Well Water
1)	Bruce	14	7
2)	Elgin	9	2
3)	Essex	12	0
4)	Grey	7	5
5)	Huron	12	10
6)	Kent	11	2
7)	Lambton	17	4
8)	Middlesex	9	6
9)	Oxford	12	12
10)	Perth	9	9
	Total	112	57

It will be noted that the distinction between public and private water works is not always clearly defined. There are many smaller water works supplying a number of premises, but they are not listed as public systems as they are generally recognized.

The majority of small privately operated water systems obtain water from the underground. In this way there is better control over the quality, although many of these ground waters are treated, usually by chlorination, Some require softening, iron removal and other adjustments.

WATER WORKS ADMINISTRATION

You Have It, Protect It

In South Western Ontario a number of procedures are followed in the administration of public water works and supplies. Much depends on the use which the water is to serve. For power purposes, the flow must be controlled or directed to the power plant; for domestic consumption, many factors become involved in preparing and delivering water to the consumer. This administrative plan may include municipal council control, public utility operation, and others. The number of privately owned water works systems serving the commun-

ities in this area is not great and is usually confined to quite small systems where municipal bodies prefer not to become involved or where a developer uses the system to advance his project.

The type of administration is likely to be more pronounced in planning for the future. The effects of this will be noted both in large and small communities. The objective will be to make water available to the highest proportion of the communal population and at minimum cost. Should the number of water works systems be kept to a minimum, with a central authority having jurisdiction over a lare area? This is the practice which has been followed in recent years in the United Kingdom. In Ontario, public utility administration has been conspicuous for many years.

Regional Governments have been created in recent years in Ontario. The consolidation of areas and municipalities under one administration may include a number of water works systems, some of which may be administered either under councils or public utilities. Just how these changes may affect the administration of these public water supplies is yet not clear.

Where water is in short supply corporation boundaries may be a cause for dissension. Permits are required from the Ministry of Environment in Ontario for taking of water, both from surface supplies and underground. Should one municipality cross the boundary into another and sink wells for its own use? The municipality with the water supply is likely to say that the water belongs to it. These boundary disputes are less likely to arise where the administrative agency embraces a large area.

The legal side of water administration is dealt with later.

The administrative agency for a municipality will be determined by that municipal body or the public at large. The kinds of agencies are shown in the county units.

WELL WATER QUALITY OBJECTIVES

An Ontario Asset

Not much treatment is now being provided for ground water supplies in the South Western area. The need for biological treatment is not to be expected when the water has seeped through a substantial layer of soil. Fissured rock formations do not offer this same filtering protection. Biological disinfection can be applied readily where necessary, and its use is increasing as an added protection.

More significant for ground water is the presence of minerals and chemicals which may affect the water user. Ground water supplies are likely to be more adversely affected by these substances than surface waters. They tend to accumulate in the underground but diminish in surface waters. Hard waters can be softened, iron can be removed, and gases which cause taste can be driven off.

Water quality objectives or standards contain limiting amounts of various substances in water intended for domestic use or other purposes. Some of these, occurring naturally in ground water and within the limits defined, are currently being questioned. What is likely to be the long term effect even if no short-term objection has been shown? The more chemicals present in the water, the greater the question to be raised about long term effects. Much of this problem must be submitted to further research. In most instances, the low mineral content would be regarded as the more favorable. But, this seems to be questioned with hardness. Some recent research has revealed that hard water has advantages in certain forms of heart disease. Other studies disagree with this conclusion. These questions occurring in recent years, but not regarded previously as significant, will arouse the researcher until the full effects may be interpreted correctly.

Many of the substances of mineral origin, do not lend themselves to treatment prior to the water being discharged into the public systems. Under

these conditions, more emphasis may have to be placed on the selection of the supply. Such a choice may be more feasible for well water than for surface supplies.

WELL SUMMARIES

As Constant As The Rainfall

The table submitted shows a summary of wells in the 10 counties of South Western Ontario. These are the wells on files of the Government.

Those features which may be related to water quality may be interpreted from the formations and the kinds of water.

These figures are taken from the wells recorded in the counties

CONSERVATION AND GROUND WATER

The close relationship exists between conservation and ground water resources and has been accepted for a long time. Even though so recognized, has effective action been taken to deal with it? That is doubtful. The effects of water resources on the welfare of a country or any part of that country are so great that every effort needs to be made to conserve this unexcelled asset. Conservation is not a case of hoarding the supply but more the protection of quality and wise use. Ground water has the great advantage of being stored in a huge underground reservoir. It is there for use and replenishment.

One of the great assets of Ontario is its water resources. Without sufficient water no community can grow and function effectively. Both surface and ground waters are essential in the well being of the Province. A large part of the water in streams and lakes is ground water that has escaped slowly from the earth and seeped into these outlets en route to the ocean.

Conservation of any natural resource means wise use of that resource. Ground water is not inexhaustible. It must be conserved and properly developed to ensure availability for the future. It is important that planning for

ground water must look many years ahead. Water now contained in a natural under ground reservoir has likely been accumulating over many years or even centuries. It may be a largely - untapped reserve to carry through periods of low rainfall or droughts. Conservation seeks to pattern the use of ground water on the basis of natural laws that control its occurrence and replenishment.

It is reported that in the United States "more than 95 per cent of the fresh water available at any one time is in the porous beds of rock and sand that make up the crust of the earth*". In Ontario, it would be difficult to estimate accurately a corresponding figure. At best this could be useful only to indicate a huge reservoir under the surface.

H. E. Thomas in his book on the Conservation of Ground Water states: "Ground water reservoirs probably hold several times as much usable water as the combined capacities of all lakes and surface reservoirs, but we do not have enough information to provide a reliable estimate as to how much water is in them."

The annual precipitation over the Southwestern Region is very large. The total acreage is given as 7,019,313. If a figure of 30 inches of rainfall is assumed, it is seen that the amount of water over the whole area is greatly in excess of the amount used. Some is abstracted from surface sources, while other is from the ground water. In either case, the surface reservoirs and the ground water basins are of great value in equalizing the demands.

The total acreage for each county is: Bruce 973,830; Elgin 464,518; Essex 460,109; Grey 1,113,056; Huron 840,832; Kent 613,107; Lambton 699,539 Middlesex 812,518; Oxford 500,608; Perth 541,216.

* "Ground Water" - National Water Well Association

GROUND WATER SUMMARIES

for

SOUTHWESTERN ONTARIO

As Recorded in the Provincial Files

County	Total Wells Drilled	Wells Ending In: Over-burden	Wells Ending In: Bedrock	Kinds of Water: Fresh	Salt	Sulph.	Mineral	Dry Hole
Bruce	3,303	162	3,196	3,185	19	72	21	21
Elgin	2,106	1,930	171	1,800	2	89	9	131
Essex	3,753	781	2,961	2,655	16	846	78	112
Grey	4,132	609	3,517	3,846	29	70	48	78
Huron	2,713	415	2,287	2,508	3	63	6	29
Kent	5,854	2,094	3,765	3,764	112	43	20	1,801
Lambton	4,414	988	3,414	2,953	65	268	19	1,058
Middlesex	6,679	4,744	1,922	4,907	16	339	24	472
Oxford	3,759	1,761	1,994	3,365	6	160	52	33
Perth	1,819	264	2,039	2,227	1	26	16	11
Total	38,532	13,748	25,257	31,210	269	1,976	293	3,746
Percentage		35.7	65.5	81	0.7	5.1	0.8	9.7

County	Water Use, etc.: Dom. or Stock	Irreg-ation	Indust-rial	Commer-cial	Munic-ipal	Public Supply	Not Used	Abandoned
Bruce	3,051	7	18	70	30	144	30	38
Elgin	1,649	8.4	26	51	11	6.7	92	190
Essex	3,134	220	39	64	5	92	124	212
Grey	3,656	8	25	128	13	145	77	119
Huron	2,384	4	19	56	21	110	52	39
Kent	3,331	20	24	96	14	96	403	2,248
Lambton	2,764	16	16	55	23	112	318	1,384
Middlesex	4,582	43	84	162	66	152	52	39
Oxford	3,165	81	80	72	30	106	118	66
Perth	1,596	20	29	58	19	80	13	19
Total	29,312	503	360	812	232	1,104	1,279	4,354
Percentage	76.1	1.3	0.9	2.1	14.3	2.9	3.3	11.3

The summaries of well data for each county make some interesting comparisons. The number of wells drilled for this list is large enough to reveal conditions, both as to cause and effects: From the total wells - 38,532 - the tabulation shows where the wells end, the kind of water reached, and the use made of that water. Analyses of the water is given elsewhere.

In the construction of the wells, the grouping shows whether the well ended in overburden or in bedrock. The latter is likely to give waters with a higher mineral content. It is interesting to note that 65.5% of the wells were in rock.

There is quite a wide variation in the well endings in the different counties. Thus, Bruce's wells are nearly all in rock, whereas the Middlesex wells are nearly 75% in overburden. The counties of Lambton, Kent, Huron, Grey and Essex have more than half in bedrock.

In the listing of the kinds of water, these tables do not give much details. The main class was whether the water was fresh, salt, sulphur or mineral. The list shows 81% gave so-called fresh water, that is it was suitable in general for home use. The amount of sulphur wells- 5.1% - seems high. Essex County leads in this, followed by Middlesex and Lambton.

The figure of 9.7% of the wells drilled resulted in dry holes. This probably is not out of line.

The uses made of these well waters show the services rendered by these wells. It also reveals that there is no great shortage of groundwater. Most of the wells - 76% serve domestic use and livestock. Municipal use at 14.3% indicates the action of municipalities in seeking ground water for public purposes.

For the question of suitability of these waters for various uses, laboratory assistance is needed. Many analyses of waters are given elsewhere in this study.

It is disconcerting to note that over 11% of the wells were abandoned. The cause is not given, whether it be a scarcity of water, objectionable quality, or other cause is not shown.

"He who passes not his days in the realm of dreams is the slave of the days."

- Gibran

"Work is the master word in the ongoing life. It is the touchstone of progress, the measure of success and the fount of hope. It is directly responsible for all advances in medicine and technology."

- Sir Wm. Osler

"The biosphere, the zone of living things that covers all the earth is so complex it may never be fully understood."

Nature has a task in spreading the required amount of water over this very large area.

Some conception of the great quantity of ground water in some places is seen in the Nechako aquifer in British Columbia. The International Water Supply Ltd. reports this to be Canada's largest water well and is used to supply Prince George. The well is a Feldman horizontal collector consisting of a 16 inch diameter caisson, 100 ft. deep, with 1788 ft. of 8 inch diameter polystyrene screen projecting spoke-like at the bottom of the caisson. On test, the well produced 15.3 mgd with 6.7 ft. drawdown.

In areas of intensive water use frequently there are contradictory opinions and confusion on the amount of water available. This is due at least in part to insufficient knowledge of data and related facts. More studies and testing are required.

Conservation is likewise not only the wise use of the water but the protection of quality. The latter must be directed against all pollutants. Exclusion of these from the ground water reservoir is the best form of attack.

In the United States, The National Water Well Association states that: "Ground water not only is the largest source of good, usable water in America today ......but it's also the secret weapon in the fight against water shortages - provided this vast, almost unlimited natural resource is developed sensibly and properly today and in the years ahead.....

.....There are single wells in the United States that yield more than 10,000,000 gallons of water every day of the year. In some localities, the fresh ground water stored in deep beds is many hundreds of years old" - another great asset of ground water.

These United States figures may not be directly applicable in Ontario, but they do offer a reasonable guide in many instances.

H. E. Thomas in "Conservation of Ground Water" states that "Americans

are face to face with problems of water supply. This is a brand new experience. In many localities rates of withdrawal have exceeded those of natural replenishment. Treatment of some watersheds can reduce overland flow, increase filtration and soil moisture, and yet not cause any perceptible increase in storage in an underlying ground water reservoir. Few ground water reservoirs are utilized to store flood flows for later use, and they are generally not even considered in river basin control and storage programs".

True and effective conservation calls for a well balanced program in which the importance of all the individual resources in the locality are given due recognition, each in relation to the other and to the whole.

What happens to water in underground storage? The quality remains high, except where some minerals may be leached out from the surrounding earth or rock, or where surface pollutants seeps into the aquifer.

CONTAMINATION OF GROUND WATER

While the source of all water supply, surface and underground, is precipitation as rain or snow, the quality is influenced in several ways by contacts with minerals, chemicals and wastes of all kinds. Biological wastes can generally be retained in the soil, acting as a filter. Silt is also strained out. The remaining problem involves those materials, which may either be introduced from the surface or be absorbed from the soils and the rocks with which the water comes in contact.

An important question is how far do these unneutralized wastes travel in the underground? Conditions vary widely, and tests will have to be conducted to be certain. Care will be needed in their disposal on the surface. Prevention is the best defence.

The manufacture of chemical products has grown rapidly in recent years. New chemical substances come on the market in great numbers. These can cause contamination in two ways; firstly, by the wastes in the

manufacture of these products, and secondly by use of the substance itself. Some of these can travel long distances without being destroyed or broken down into harmless matter. They are a real problem to those concerned with the protection of water resources. It is well to examine some of these and how they may react on the water consumer.

Water quality standards have been widely prepared for those constituents likely to be found in drinking water. Following is a list of inorganic substances which may be present in ground water, along with the recommended safe limits for domestic consumption. These are subject to change.

Element	Recommended Limit - (mg/l)
Arsenic	0.05
Barium	1.0
Boron	1.0
Cadmium	0.01
Chloride	250
Chromium	0.05
Copper	1.0
Fluoride	1.0-1.2
Iron	0.3
Manganese	0.05
Nitrate (NO_3)	45.0
Selenium	0.01
Silver	0.05
Sulfate (SO_4)	250.0
Total Dissolved Solids (TDS)	500.0
Zinc	5.0

Other elements may be included, some of which are under investigation.

Further limiting figures have been set for other uses of water, such as irrigation, fish, and industry.

It is incumbent that ground water shall not exceed these figures. These substances must be classed as pollutants. As such, they should be excluded from the surface or be effectively treated before discharge.

Little can be done about those minerals and chemicals present in the

earth. The action here should be to choose a location for the well that will exclude these substances from the water route.

The analysis of well water in use in South Western Ontario is important in a determination of where suitable water may likely be found. In this area, certain constituents have for a long time been noted in choosing a supply for domestic use. Hardness and iron are examples.

Hardness, as one of the common ingredients in well water, is prevalent in certain parts of the area. It is high in limestone formations.

Hardness may be defined as a characteristic of water which represents the total concentration of just the calcium and magnesium ions expressed as calcium carbonate. The boundary line between hard and soft waters may be taken as 80 to 100mg/l. It will be seen in the analyses of waters, included in the County reports, that many must be classed as hard waters.

Effects of Hardness - Hardness in water has for a long time been regarded as a nuisance or inconvenience. It makes water less attractive for bathing and all domestic use. It coats hot water piping and vessels and thus reduces the efficiency of heating systems. Thus, consumers seek water of low or medium hardness for most uses.

Hardness in drinking water has been subjected to further research in recent years. Some researchers have indicated lower heart disease rates for hard water consumers than for soft waters. This interpretation is not conclusive and further studies are being made. At any rate there is no indication at this time that hard water is detrimental to health.

This study on the effects of hardness is a further example of different findings in a subject which has remained dormant for many years. How much change in findings is likely to be found in other constituents of water? The less of these substances in water, the better it would be, it seems.

Iron, absorbed by the water from the intervening formation, is found in several places in this area of study. The recommended limit is 0.3 parts per million or less.

Iron is not considered detrimental to health, but it is objectionable in several ways. Some ground waters may contain more iron than surface supplies. Iron in water may be either in true solution, in a colloidal state, in the form of inorganic or organic iron complexes, or in the form of relatively coarse suspended particles. It may be either ferrous or ferric or both.

Iron is objectionable in that it causes taste, staining of sanitary fixtures and laundry. It may also cause a bitter, sweet astringent taste, detectable by some persons at levels above 0.3 mg/l. For this reason, specific limits are in general use. The figures for these well waters are shown in the analyses for the wells in the tables. Another factor involves "iron bacteria". They are capable of withdrawing iron from the water and depositing it in the form of hydrated ferric hydroxide, or in mucillaginous secretions. Further there are a large number of organisms which either utilize iron or cause its deposition.

Hydrogen sulphide, because of its objectionable odor and taste, is not desired in drinking water supplies. It can be expected in certain areas.

The limit recommended for sulfate in water is 250 mg/l. In drinking water there should be no detectable amount of the sulphide gas.

Similarly, other substances which exceed the objectives set up are to be avoided regardless of the source.

There is a distinction to be made for the quality of water used for short periods and for long terms. The latter must be the objective. As further research proceeds new interpretations may be forthcoming on the effects of minute quantities of elements.

Care is needed also about the presence of insecticides and pesticides in such common use at present. The protective barrier of the ground formation gives an advantage to well water over surface supplies. But some of the modern wastes can penetrate long distances in soil - Hence, the need for care in the use and disposal of these substances takes on added significance.

Viruses are likely to be more prevalent in surface waters than in gound water. Treatment is essential where any danger from these may exist.

SUBSURFACE DISPOSAL OF WASTE

It stands to reason that the greater the distance a contaminant has to travel through the earth's formation the less will be the chance of pollution of the ground water. Hence very deep wells are unlikely to be contaminated from surface deposits. This assumption is predicated on the formation being a mixture containing a substantial amount of fine material. Fissured rock offers little in the way of filtration, and a contaminant may travel a long distance without being removed or affected.

The foregoing predication or assumption comes to play in the deposit of municipal garbage or refuse either on the surface, in a valley, or in a man-made excavation such as a gravel pit.

Domestic garbage has a high biological content. Rainfall tends to leach out this organic waste. If it can find a direct course to a drainage outlet, there will be resulting pollution of the stream. If the deposit is in a low area or in an excavation, the tendency will be for this liquid to seep into the ground. If the barrier is not great enough to impede or remove this substance, it must be expected that underground pollution will result. The distance this may travel in an active state is not readily determined. Observations on test wells in the vicinity of waste disposal points are desirable.

The danger from this leachate becomes greater when chemicals, minerals and toxic wastes are permitted in the refuse dump. These modern chemical mixtures may have intense toxic reactions. Some also may travel great

distances without breaking down.

The selection of a refuse disposal site or landfill, hence, assumes major importance. Soil tests will be helpful, and the natural drainage will need study. Obviously, a knowledge of the geological formation will be important, along with the distance from the surface to the ground water level. All of this constitutes a study of what can be expected when these solid wastes are placed on or near the surface.

The trend to develop complex substances, with wastes therefrom difficult to purify, has brought a desire to dispose of these in formations at great depths, several thousand feet. This is below the fresh water supply formations. When the waste is pumped into these depths, it is expected to disperse over a corresponding distance without coming back to the surface. How much danger is there from this practice? What are likely to be the demands in the future for the use of this method? These questions are not easy to answer precisely.

Subsurface disposal wells have been sunk in certain places in the South Western Area. Some information is available about these wells. It must be recognized that in this practice there is some element of risk against ground waters. These waters are of such great importance that no recognizable risk should be taken.

THE PRACTICE IN CANADA OF SUBSURFACE DISPOSAL

VanEverdirgen in Technical Bulletin No.78 of the Inland Waters Directorate of Environment Canada in 1974 examined this practice of deep well disposal under the title - "Subsurface Disposal of Waste in Canada" - He points out the need for an adequate understanding of injection-well and disposal-information hydraulics as a prerequisite for the formulation of criteria for the selection of suitable sites and formations.

Use is made of the relatively well-known non-equilibrium approach in which the disposal formation is assumed to be homogenous, isotropic and of infinite areal extent, with non-leaky confining beds. That may be taken

as the requirement for the formation. The fluids for disposal are assumed to be of uniform density, with the viscosity being a function of temperature and of pressure. The injected liquids are not expected to react with the formation, rock or water.

The distance of the waste movement is calculated from an equation in vanEverdirgen's bulletin. He also shows a table containing the total distance for the substance to move in the downstream direction. This shows a total mileage of 0.0905 after one year and a distance of 1.133 miles after 100 years. The operation and maintenance of these wells require careful supervision.

A number of conclusions are cited in Bulletin No.78, some of which are:

(1) The magnitude and extent of the pressure increase in a disposal formation during continuous waste injection depends on a number of listed factors.

(2) Undesirable changes in the performance of a disposal system usually gives rise to relatively rapid changes in injection pressure and/or rate.

(3) Well head examinations should be measured regularly to ensure early detection of problems.

(4) Automatic warning signals or shut-off valves should be activated by the well-head monitor when the "maximum safe" pressure is reached.

(5) The technique of hydraulic fracturing should not be used to increase the receptive capacity of a waste disposal formation.

(6) The radius of the waste "cylinder" in the disposal formation around an injection well as calculated by equation is a minimum value.

(7) Injected waste will move, though slow, through the disposal formation, even after injection has been discontinued.

(8) The cost disadvantages of selecting the deepest suitable formation are out weighed by the gain in safety margins. In some cases, the paucity of subsurface data for greater depths may necessitate the drilling of a number of test holes to define subsurface conditions more adequately.

It must be apparent that great care will be required to protect ground water against contaminants of all kinds and from all origins. This provides conservation in the highest form. As the area of South Western Ontario grows in population and in industries, corresponding care will be essential to protect this great natural resource.

WATER LEGISLATION

Legislation for the control and management of water supply and systems has developed over many years. Amendments to the original acts have been numerous and frequent. The result has been a gradual development to what is now considered best for today's needs. All the various aspects of water works systems are included.

The legislation pertains in this province to three levels of governmental agencies to deal with specific features of the administration. These are local, provincial, and federal. In Ontario, local bodies are councils, public utilities, and private agencies are given authority by the Province, a procedure such as in The Municipal Act.

The Federal Government of Canada has only a limited part in the administration of public water works systems. The Province, as distinct from this, is empowered to pass enactments which control as well as authorize local agencies to act. The Municipal Act, originally passed many years ago, and now extensively amended, provides a base for local councils. Closely related to this is The Public Utilities Act, again enabling legislation.

Local municipalities are given extensive authority by the Province to manage water works. The administrative details may be under the direction of the Council, or the authority may be delegated to a Commission or

similar agency. The Commissioners are elected by vote. The right to issue debentures for capital works still rests with the Council as the one body responsible for the financial stability of the municipality.

In public health matters, responsibility for the safety of the supply is divided between the Province and the local Board of Health. In the early days of public systems, the prevention of disease being transmitted through the water supply was a constant responsibility. The Province was accordingly given the right to issue orders for works needed to protect public health. The wide spread use of chlorination reduced this risk to a low point.

When the Ontario Water Resources Commission was created in 1956 much of the Province's responsibility passed to that body, and subsequently to the Minister of Environment.

At the municipal level, the Medical Officer of Health, acting through the Local Board of Health, is given wide powers to deal with any condition which may be a danger to health.

The day to day operation of water works is carried on by the body designated by Council. This may be a department of municipal government reporting directly to Council or it may be a utility commission. The latter has been widely used in Ontario, mostly being a joint operation with the electric supply.

THE COUNTY REPORTS

The foregoing is a general statement and commentary on the ground water resources of the 10 counties in Southwestern Ontario. The wells are studied in each of the counties, and a separate statement prepared on each. Thus, each county can be taken jointly with the general report or separately from the others. The procedures followed in each is much the same. Statistics, descriptions, interpretations, and findings are made for each county. These are included more fully and for convenience in the report as appendices.

The general findings in each of the counties are described herewith:

1. BRUCE COUNTY

The area of the county is 973,830.4 acres, the second largest of the 10 counties. The assessment was $383,657,000. and the population in 1975 - 52,313.

While the records of drilled wells are increasing continuously, the figures available at this time showed a total of 3,363. Some 3,185 of these were in fresh water, but only 162 were in overburden, and 3,196 in bedrock.

Public water works systems are recorded in operation in 14 municipalities. Those using surface waters numbered 6, with the others using ground water. The population of the municipalities with public works totalled 25,573, of which 11,327 or 44% were on ground water, thus reflecting use in the smaller centres. The proximity of Lake Huron to some of these made it convenient to use the lake supply.

It is difficult to obtain up-to-date information on the total annual water consumption in the municipal systems but it may be estimated that this total is approximately 3,035,200 gallons per day, with 43% or 1,296,200 gallons coming from the underground reservoirs.

The chemical analyses are of special interest. Lake Huron is of good quality with a hardness content of somewhat over 100, and a low iron content. The ground water in most instances is hard at 250 to 300 or more mg/l. Iron varies with some within the recognized limit and others high enough to require treatment.

A number of privately operated water systems are in operation, and each supplying from a few to 150 services. The Ministry of the Environment and the local Boards of Health supervise these waters closely. Such small systems need to be regarded as temporary units until larger municipal works are available.

A number of other items are listed in the summary for this county.

2. ELGIN COUNTY

Elgin County, in the more southerly part of Southwestern Ontario, has an acreage of 464,518.4. It is one of the larger counties, and has a population of 68,232, of which nearly 43% was in the townships.

Drainage is via a number of creeks emptying into Lake Erie.

The number of well records on file at the time was 2,106 of which 85% were in fresh water. The characteristics of some of the larger wells in the county are shown in the county's tabulation. Naturally, there is much variation in depth and rated capacities.

Conservation is important in Elgin, and two authorities are active, one on Catfish Creek, and the other on Kettle Creek.

Public water works systems are in operation in 9 communities. The largest of these is the City of St. Thomas. A recent change in source of supply took place for St. Thomas with Lake Erie water being utilized through the Provincial System. Surface water is also used at West Lorne, Dutton, Rodney, and Port Stanley.

Well waters are supplied to the other municipal systems.

Rural areas must rely chiefly on wells.

The chemical content of these waters is often high, but not in excess of the prescribed public health limits. Hardness, iron and fluorides are significant; the municipal supplies from wells are high in hardness but not excessive. The others are not great.

3. ESSEX COUNTY

The area of Essex County is 460,108.8 acres. The favorable location of this county and its many other attractions make for growth in population and industrial expansion. The assessment in 1975 was $3,063,078,000.

The population of the County was 310,342 of which 237,369 or 78% is in the urban centres. The large population of the City of Windsor (198,569) makes for a high figure for the County.

Drainage is a complex problem because of the low, flat terrain. Outlet facilities are at hand through the river and lake.

There is much limestone and dolomite, and many of the wells are in rock formations. The tabulation of well data in the appendix shows many wells. A number of these have high capacities.

The records of wells on file in the Ministry of the Environment showed a total of 3,753. These are being added to continuously. Some 71% of these yielded fresh water, and 23% sulphurous. Nearly 80% of the wells terminate in bed rock.

The chemical analyses of well waters show in general, high hardness and iron. The big percentage of water in use is from surface supplies.

In this County, a number of wastewater disposal wells have been constructed. This has been for wastes that are difficult for treatment.

Public water works systems are in operation in 12 communities. Ground water use in these is not extensive.

4. GREY COUNTY

Grey County has a large area of 1,113,056 acres, and includes one city, Owen Sound. There are also 4 towns, 6 villages, and 16 townships. The population is not large, 69,182, with 25.7% in the city and 25.7% in towns and villages. The township population is 47.6% of the total.

The total equalized assessment was $580,051,000.

The drainage system enables a quick runoff to the streams, and hence to the major outlets.

Public water works systems are in operation in 7 communities.

The industrial needs for water are not relatively great. Rural water supplies are important in a county of this composition.

The well drilling records are listed. A common depth exceeds 100 feet. The well drilling summary shows 4,094 wells. It is interesting to note that 3,479 of these are in bed rock and 609 in overburden. So also is it encouraging that 3,808 of the wells, 93%, give fresh water. The use of the wells shows 88¢ for domestic or live stock.

The municipal systems use surface and ground waters. Owen Sound has had a public water works system since 1880, with the supply coming

from Georgian Bay and springs.

The spring water is much harder than the surface supply. The surface water is fluoridated.

In Flesherton village, as an example, the water comes from individual wells. Analysis of these in January, 1975, reveals all to be hard waters, from 240 to 328 mg/l.

In the townships, a number of small systems are in operation. Most of these are wells.

5. HURON COUNTY

Huron County possesses a long lake front and is a prominent part of the Great Lakes System with its great quantity of high quality water. This is in competition with inland supplies.

The area of the County is 840,832 acres. The population was 54,671, and the total assessment was $382,893,000. There is no city in the County, and the largest town is Goderich. The towns and villages account for 42% of the total population. This leaves a large portion for the townships.

The main drainage outlet to the Lake is the Maitland River emptying its flow at Goderich. The Maitland Valley Conservation Authority covers the watershed.

Paleozoic rocks underly the County, and impart a chemical content to the water.

There is no lack of water for industrial purposes.

The well drilling records on file show a good number spread throughout the townships and villages.

The public water works systems are in use in 12 communities, 5 towns and 4 villages. All these except Goderich are supplied from wells.

The provincially operated water plant at Goderich had an annual output of over 373 m. gal., and for a maximum day over 1.8 m. gal.

The chemical analyses of the well waters show, as might be expected, a high figure for hardness - over 300 mg/l. Fluoride is also present in

many of the supplies - some in excess of the recommended amount. Iron is also prevalent.

A large number of semi-private water works are in operation in the townships as shown in the overall list. These are ground water supplies.

The analyses of these well waters may be compared - unfavourably - with recommended standards.

In the County 11 observation wells record the water levels - a good system for checking these waters.

The County of Huron is favoured in the quantities of water available but unfortunate in the chemical contents of these waters.

6. KENT COUNTY

Kent County is favoured with a southern location and is adjacent to Lake St. Clair and Lake Erie. It is a prime agricultural area.

The total population of 103,229 of which 37% is contained in one city, Chatham, and 27% of the total in towns and villages, while 36% is in the townships.

The Thames River divides the lands of the County. It is an important drainage outlet and can supply water for irrigation if needed.

The majority of the water wells obtain water from saturated sands and gravels of varying thicknesses.

The former public water supply for the City of Chatham obtained from the Thames River is now using Lake Erie water.

The rural wells recorded for the County are not numerous. The static levels are shallow. The chemical analyses reveal more moderate amounts and some quite low in hardness. Fluoride is present in a number of the supplies in beneficial quantities. Iron is present in a number of the supplies.

Conservation is directed by the Lower Thames Conservation Authority.

Municipal or public water works are in operation in 11 places.

A number of semi-private water works are in operation. These are relatively small, but they usefully serve a number of small communities.

The chemical analyses of the water supplies shows the Lake Erie supply for Chatham as much more favourable than the former Thames River source having a hardness of 256 mg/l, iron 1,95 mg/l, and color of 40.

The recording of ground water levels in the County is facilitated by the use of 7 observation wells.

Important strides have been taken in the provision of suitable water supplies. Others are expected to follow.

7. LAMBTON COUNTY

While Lambton County is adjacent to two major watercourses, Lake Huron and River St. Clair, the solution to water problems has been difficult for the inland areas.

The County has an acreage of 699,539.2 and a population of 114,166.

The Sydenham River provides a drainage outlet to Lake St. Clair.

Two geological formations affect the ground water supplies, both in quantity and quality.

Industrial water use is high, and is supplied mostly from surface waters. The assessment for the County is 398 millions.

Over one-third of the population of the County resides in the townships. Water is obtained for these rural sections from wells. These are relatively few in number as deep wells, but shallow wells serve.

The St. Clair Region Conservation Authority is organized to serve the County in that field.

Public water works systems are in operation in one city, Sarnia, two towns and fourteen communities. Efforts are currently being made to provide a more adequate water supply for inland areas.

A substantial number of semi-public water works are in operation, drawing mostly from the underground and serving parks and groups of premises.

The water analyses for these systems are quite variable. Hardness in the surface samples was approximately 100, while the ground water was higher, some being over 300 mg/l. Other constituents were likewise variable. In general, the water analyses were not objectionable, but the quantity of water was difficult.

To record the water levels in the aquifers, two observation wells were in use.

Deep well disposal of concentrated wastes has been studied extensively in this County and more use made of it than most other places.

This County is one in which the development and conservation of ground water requires special attention and continuous study.

8. MIDDLESEX COUNTY

Middlesex County has an area of 812,518.4 acres. The focal point in many respects is the City of London. Two towns and six villages make up, with the city, the urban section. There are 15 townships. Some 80% of the population is in the city. The towns and villages had only 4% of the total, while the townships had 16% of the population. Population - 304,824.

The Thames River, north and south branches, provides drainage for the County.

The Upper Thames River Conservation Authority operates in the County.

The need for water in rural areas is great. The tabulation of the well drilling records shows many wells. This is an area in which drilling has been active for some years. Many of the wells were intended for use in the urban areas.

The public water works systems supply nine centres. The London water supply from Lake Huron surpasses all others in volume. The new supply from Lake Erie gives additional support to the needs of the London area.

Ground water was formerly used by the City.

As in other counties a number of semi-public water works are in operation.

A close check is maintained on the water levels for the wells. Observation wells are in use in strategic points.

The water situation in Middlesex County has been critical. Much drilling went on to keep ahead of the demand. The lake supplies changed the picture and will aid materially in the development of Metropolitan London.

9. OXFORD COUNTY

Historical Oxford has one city, Woodstock, 2 towns, 4 villages and 11 townships for administrative purposes.

The total population is not big at less than 83,303 of which 32% is in the city; the townships account for 44%. This indicates an agricultural status of the County. It is an inland area.

The Thames River provides a drainage outlet for part of the County.

The rural and inland areas must depend on wells for water supplies. A compilation of the well records shows 3,759 with 1,994 of these in bed rock.

The County has been conspicuous in conservation measures.

Public waterworks systems have been in operation in 7 urban municipalities, the earliest being at Woodstock since 1880. All are on wells.

Information on these municipal wells is tabulated in the appendix.

Water analyses show hard waters, with other ingredients in several instances in excess of recommended standards. In general, the ground waters are highly mineralized.

Semi-public water works are in operation in a number of places, with water coming from wells. The chemical analyses of these waters are high in minerals.

10. PERTH COUNTY

The inland county of Perth has a good record in ground water supplies.

The area of the county is 541,216 acres and a total assessment of $155,949,845. The population is 64,984 of which 24,048 is in the one city, Stratford. The administrative organizations are in 3 towns and 1 village, and township areas.

Drainage outlets are provided in the Thames River and the Maitland River. They are not large streams.

Limestone is prevalent under the County; and this affects the quality of the water.

Industrial waters can generally be secured from local wells.

The Upper Thames River Conservation Authority has been active for some years in the County.

All municipal water systems rely on ground water. Adequate quantities of water are not always available locally, and it is necessary to bring water a distance. An example of this is the supply for Centralia being delivered from a well in the Kirkton-Woodham area.

The records on wells on file reveal a total of 1819,

The analyses of water from wells show high mineralization. Some are quite hard.

Observation wells are in use in 6 locations.

FINDINGS AND CONCLUSIONS

This examination of the Ground Waters in Southwestern Ontario has resulted in the following findings or conclusions. These are for the entire area. Further details are set forth in the material for each county.

(1) Southwestern Ontario has been fortunate in the availability and quality of both surface and ground waters, but the time is at hand for a program which will conserve these waters for best use both in quantity and quality.

(2) This report contains information on waters used for domestic consumption and industry. The public water works systems are listed, along with related data.

(3) Modern cities require large quantities of water for many uses. In this area there are 8 cities, and these obtain water from surface supplies and wells.

(4) The total population supplied in cities is in concentrated areas. The two largest cities, London and Windsor use surface supplies. In some counties all municipal systems use ground water and in some all surface waters.

(5) The consumption figures are changing continuously as might be expected. The consumption for all systems in the area may be estimated at 100 gallons per capita per day. To this figure must be added the separated industrial uses and the rural areas. The selection of the sources of supply has been closely related to the availability of a suitable water. To this must be added capital cost and operating expenses.

(6) The number of municipal or public water systems in Southwestern Ontario withdrawing water from the ground was 57 in a total of 112 systems.

(7) The total precipitation over the area was estimated at approximately 30 inches per year. A portion of this seeps into the ground water reservoirs and can then be withdrawn for municipal and industrial uses.

(8) Included in this report is information on the municipal systems taking water from surface sources. There is thus a means for comparing the different waters, both in quantity and quality.

(9) Rural water systems are numerous. Mechanical equipment for operating these works is now prevalent, and this permits an essential service to the populations in the townships and small communities. The high percentage of these supplies comes from the ground aquifers.

(10) The chemical analyses of public and semi-public water supplies are listed. They show wide variations. The analyses most widely determined in the laboratory has been hardness, iron, chlorides, and fluoride. The frequency of analyses and the scope of the examinations have increased considerably in recent years. This is a commendable move.

(11) The comparison can be made between the desirable standards for water to be used for domestic consumption and the actual laboratory results on these waters.

(12) The importance of maintaining a close check on the chemical composition of water supplies cannot be overstressed. It must be remembered that these drinking water supplies are being consumed continually, and hence any small amount of

pollution may build up or adversely affect the human system. Some constituents which were disregarded previously are now being scrutinized carefully.

(13) It is not easy to define to what extent the drinking water supplies are polluted. It will depend on the definition of 'pollution'. If it is confined to biological substances and toxic materials, no great problem arises in this statement of polluted and safe waters. But if the much broader yardstick is used, and related to minute quantities of the substances, the problem of classification is much more complex.

(14) The records of wells drilled in this area are on file in the Ministry of the Environment (formerly a part of the Ontario Water Resources Commission). These cannot be expected to include all the wells sunk or in use, but the records are the most reliable available. The number of wells, and related data, are given for each county. This makes a total of 38,532, and this number is being added to continuously.

(15) Conservation of ground water is of increasing importance. This needs to be conservation in the true sense, that is, the wise use of this resource rather than non-use, and the strict prevention of pollution.

(16) It is difficult to assess accurately the conservation measures now in use and in relation to the protection of ground waters. Conservation authorities now cover the area. What other measures can be taken to improve conservation depends on public agencies and all individuals.

(17) The geological formations in the Southwestern area of the Province are shown to favour the development of ground water, but the resulting addition of chemicals to the water is inevit-

able. Hence, the selection of the well site and its maintenance are important.

(18) A series of observation wells are in use in the area. These are important in determining the water levels and the effects of circumstances on these.

(19) Similarly, the use of deep well disposal for the discharge of chemical and toxic wastes is in practice in some areas. It is more prominent in industrial sections. If permitted at all this practice should be most rigidly supervised and controlled.

(20) Legislation and administration, at the provincial and municipal levels, are well developed in this area in respect to present day practice.

(21) The administrator of ground water services needs reliable aids. These include trained and conscientious operators, convenient and efficient laboratory services, and sufficient legislation to make the program workable.

(22) It cannot be said there is any real shortage of water in this area. Steps may have to be taken in some sections to transport water some distance or to increase the inflow and storage of water in the aquifers.

(23) The reuse of water must be recognized as a desirable practice. Infiltration into the ground water reservoir can be a substantial asset. It has not been practiced to any large extent in this area. Studies need to be made on the feasibility of this in the differenct sections. Wastewaters would require adequate treatment before passing into the aquifers.

(24) Miscellaneous other matters require continuous scrutiny if the conservation of ground water supplies is to be effective.

The drilling and development of wells, their maintenance and prevention of pollution require close attention.

APPENDIX

I

COUNTY OF BRUCE

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

1 9 7 7

CONTENTS

COUNTY OF BRUCE

COUNTY OF BRUCE

Geography has favoured the County of Bruce with convenient access to Lake Huron. The County's shoreline extends from Amberley on the south to Oliphant on the north. Along with Huron County there is a lengthy lake shore water supply available to adjacent municipalities in any quantity desired. In contrast, most inland communities are not large enough at present to support an expensive pipeline from the lake. Hence rural waters assume an important status in the welfare of the County. These places must rely principally on ground waters.

Bruce County is steeped in history. January 1850 was its birthday. It has been and is still a glamorous area. The Indians and the early settlers left their marks on the Country. Steam boat traffic had a prominent role in the early days. Forests and lumber mills were conspicuous. For centuries the area was prominent among the numerous Indian Nations, then, successively between Indians and French and between French and English.

The book by Sherwood Fox - "The Bruce Beckons" - contains some fine comments on the Peninsula. He writes:

> "In regard to Lake Huron it is a sword that has cleaved a body clean in twain: instead of one lake there are two."
>
> "The Bruce is one of the world's remarkable peninsulas. Like the others, it has been cast by nature as though, by design, to block a main highway of water traffic. What Jutland is to Germany and Denmark; what the Iberian Peninsula is to the Mediterranean and Western Europe; what stormy Mount Athos was to Greece and to the invading Xerxes, so on its own modest scale the Bruce Peninsula is to Lake Huron and the Georgian Bay.
>
> The Bruce remains the impediment that nature made it, and there is no reason to change it."
>
> "What then shall we do with the Bruce? The answer is not far to seek. Enjoy it, I say, for it abounds in wonderful things."

The foregoing observations reflect on the availability of surface waters, but also on the need for ground water for the inland

areas of the County.

THE COUNTY

The County has a total acreage of 973,830.4 of which 11,948.8 or 12.3% is in the towns and villages. The balance is in 16 townships. The total population (1975 statistics) is 52,313, of which 25,932 is in towns and villages (or 49.6%). The even distribution between urban and rural populations is noted and is influenced largely by lack of a city in the County.

All six towns have public water works systems, and of the nine villages all but one have water works. Two of these are privately owned.

The Bruce Peninsula extending northward to Tobermorey, is flanked by Georgian Bay on one side and Lake Huron on the other. This proximity to large bodies of surface waters offers opportunities for the development of heavy water using industries or large populations. These at present do not exist there.

DRAINAGE OF THE LAND

Drainage of the lands of the County does not appear to be more difficult than elsewhere. Agricultural lands can be drained through field tiles, with outlets to convenient ditches. In all of southern Ontario there arises the costly problem of providing drains. Some government subsidy is provided.

This rainfall is either carried away quickly or it seeps into the underground to provide the groundwater for local residences.

The main drainage outlet to Lake Huron is the Saugeen River, with all its tributaries, emptying into the lake at Southampton. The narrow width of the peninsula makes for easy drainage. The Sauble River and its tributaries outflow to reach the lake near Sauble Beach. Both Sauble and Saugeen Valleys have conservation authorities.

GEOLOGY OF THE COUNTY

Geological circular 13 on Rocks and Minerals of Ontario shows that much of the County is in the Detroit River Group - limestone and dolomite; some in the Salina Formation - shale, gypsum, dolomite, and salt; some in the Bois Blanc Formation of cherty limestone. The Peninsula is largely Guelph Formation - dolomite.

These geological formations tend to contain water with a high mineral content. This shows in hardness, chloride, fluoride and total solids, making the water less suitable for domestic and industrial use. The contents of the waters of individual wells will reveal these figures in more detail. - see analyses.

RURAL WATER SUPPLIES

Any county with such a high percentage of the population in rural areas will be concerned with the quality of the water, as well as with the availability of supply. The overburden generally provides a filter to remove biological products, but only to increase the chemical contents.

Rural areas have depended in the past on many dug wells. Later drilled wells have been the answer. These vary greatly in depth, and efforts are made to get sufficient depth to ensure needed water in dry periods.

The proximity of the County to the Lake and Bay makes the question of crop irrigation an acute one. As agriculture is intensified, what will be the future practice? No doubt, if water can be made available at an attractive price, it will be used on crops. Hence, planning for the future should not overlook this use. This practice is increasing elsewhere.

WELL DRILLING RECORDS

The following data show some of the characteristics of many of the larger wells in the County. Most of these are for rural use. Some wells for urban centres are in rural sections.

ALBEMARLE TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM	
Ont. Dept. of Highways	3	22	5	96	6	50	
C. Hamilton	3	27	5	113	3	30	
Pentecostal Assembly	3	27	5	108	4	30	
AMABEL TOWNSHIP							
Chesley Lake Camp	1	17	7	303	10	30	
W. Pruder	25	12	5	31	9	48	
Saugeen Indian Reserve	D	19	6	160	Flow	25	
Carsons	D	22	6	157	20	50	Sulphur
G. Budd	D	45	4	60	5	40	Sulphur
E. Reider	D	47	4	59	3	45	
D. A. Telford	#2710		5	90	5	75	
H. Nichol	RS	1	5	50	2	59	
ARRAN TOWNSHIP							
K. Wagner	3	12	4	128	20	30	
Ont. Dept. of Highways		44	7	288	20	20	
BRANT TOWNSHIP							
Hanover P.U.C.	2	65	12	111	8	700	
Walkerton Golf Club	1	17	10	112	8	200	
Walkerton P.U.C.	1	19	10	90	18	200	
Saugeen Golf Club	1	57	5	154	20	25	
Hanover P.U.C.	2	64	2	132	10	36	
Several others by P.U.C.							
R. Walker	1	33	6	102	54	50	
BRUCE TOWNSHIP							
A. Gilchrist	2	33	4	141	Flow	40	
A. Sampson	11	34	5	114	1	32	
Dept. Lands and Forests		4	6	124	2	40	
HEPC		18	6	77	9	48	
CARRICK TOWNSHIP							
E. Goll	A	33	4	163	68	30	
B. Patterson	13	35	4	97	5	30	
Mildmay School	D	27	7	318	43	55	

CHESLEY TOWN

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM
A number of small wells						
CULROSS TOWNSHIP						
B. King	2	31	4	185	Flow	30
A. Christiansen	14	24	5	96	22	40
GREENOCK TOWNSHIP						
Separate School	6	6	5	80	34	30
HURON TOWNSHIP						
W. Ferguson	1	78	4	297	73	30
Cheese Factory	5	36	6	253	60	100
Ripley Village	8	16	8	277	44	200
J. Reis/F. Kuhner		10	6	244		30
G. Gerster		4	6	268	Flow	40
Lynian Holdings		8	6	244	8	40
G. Emmerton		28	4	196	Flow	40
Bruce Beach Well		50	4	223	Flow	30
KINCARDINE TOWN						
M. Johnson	2	32	4	157	27	30
KINCARDINE TOWNSHIP						
C. Silverthorn	5	11	5	232	58	90
D. Green	7	5	4	86	49	30
Maitland Redi Mix	12	4	6	260	65	30
Kincardine Public School	A	18	5	277	122	25
N. J. MacGregor	A	19	6	152	38	38
M. Lyons	A	44	6	168	61	35
R. P. Murray	A	47	6	184	63	36
W. Vandam	A	60	16	87	15	140
Bigelow Mobile Homes	C	60	6	205	45	200
KINLOSS TOWNSHIP						
J. DeBoer	1	122	4	127	14	36
Whitechurch P.U.C.	1	3	6	181	38	45
LINDSAY TOWNSHIP						
W. H. Barney	1	8	5	50	18	27
LUCKNOW VILLAGE						
Village	#1877		6	180	18	50
Village	#1879		6	193	16	300
Village	#1880		8	193	15	503
Village	#1878		8	182	18	145

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (Ft)	STATIC LEVEL	RATED GPM
MILDMAY VILLAGE						
Village	#2162		10	114	Flow	150
PORT ELGIN TOWN						
Town	#1883		8	196	Flow	
ST. EDMUNDS TOWNSHIP						
A. Carver	#1979		4	63	18	45
TARA VILLAGE						
Village	#2115		6	250		48
Village P.U.C.	#2170		8	346	16	30
United Dairy and P.U.C.	#2119		6	410	47	48
Four Way Milk Prod.	#2116		10	391	20	70
Village	#2117		10	389	22	97
TIVERTON VILLAGE						
A. Dent	#2695		8	157	48	107
J. McFadyen	#2121		6	239	50	30
H. L. McArthur	#2746		8	305	45	80
WALKERTON TOWN						
P. U. C.	#2134		10	163	47	40
P. U. C.	#2133		10	94	12	40
P. U. C.	#2122		8	252	Flow	175
P. U. C.	#2130		28	38	14	18
Canada Packers	#2135		12	100	Flow	600
Bruce County Home	#2128		8	113	70	38

SUMMARY

BRUCE COUNTY WELL DATA

(as prepared by Ontario Ministry of Environment)

The following is a summary of the drilled wells on file with the Ministry - April 1976.

Total Wells: 3,363

Wells ending in

(a)	Overburden	162
(b)	Bed rock	3,196
(c)	Fresh water	3,185
(d)	Salt	19
(e)	Sulphur	72
(f)	Mineral	21

Bruce County Well Data - continued

(g)	Dry hole	21

Uses of water

(a)	Domestic or stock	3,051
(b)	Irrigation	7
(c)	Industrial	18
(d)	Commercial	70
(e)	Municipal	30
(f)	Public supply	144
(g)	Not used	30
(h)	Test hole	18
(i)	Abandoned	38

The above summary shows clearly the high percentage of wells in bedrock (95), and the corresponding high percentage (95) had fresh water. Some 3,051 wells (90%) are used for domestic or stock. The other uses and conditions may be noted. The number of wells being so highly mineralized as to be non usable is small.

WATER LEGISLATION

Over the years much legislation has been applied to water works administration. Most of it has a provincial origin and is designed to give necessary authority to local agencies. An example is The Public Utilities Act. Others are The Conservation Authorities Act, The Water Resources Commission Act, and others contained in several Acts of the Legislature.

The procedures under these different Acts continue to serve in the conservation and administration of ground water.

CONSERVATION AUTHORITIES

Conservation Authorities in Ontario have carried on their programs for a number of years. Their objectives have been defined as the wise management of the renewable natural resources of the watersheds. This includes water, soil, forests, and wildlife resources.

The conservation of ground water is vital to the welfare of the area. This embraces many activities such as the holding back of

flood waters and equalizing flows, erosion control, and pollution prevention.

In the County of Bruce, two Conservation Authorities are in active administration - the Saugeen Valley and the Sauble Valley Authorities. Their programs are extensive and beneficial to all these localities.

WATER USE DATA

Information has been compiled on water use and particularly ground water. These data are tabulated herein, and interpretation of the findings is made.

PUBLIC WATER WORKS SYSTEMS

Municipality	Date Constructed	Population Supplied	Water Source
Chesley	1909	1,749	ground water
Kincardine	1889	3,912	Lake Huron
Port Elgin	1907	4,463	Lake Huron
Southampton	1901	2,392	Lake Huron
Walkerton	1891	4,512	ground water
Wiarton	1888	2,087	Colpoy Bay
Lion's Head		474	Georgian Bay
Lucknow	1890	1,089	ground water
Mildmay	1908	995	ground water
Paisley	1888	918	Teeswater River
Ripley		540	ground water
Tara		662	ground water
Teeswater		988	ground water
Tiverton		792	ground water
Total		25,573	

In the above list of public water works systems, both surface and ground water supplies are included. A comparison of the results in analyses can then be made.

As might be expected, those near a lake or river of suitable quality are making use of those supplies. In the list of 14 water works systems, 8 depend on ground water. Three towns use Lake Huron.

WATER CONSUMPTION DATA

Municipality	Average gallon per day (approx)	Per Cap/day Average	Rated Capacity M.G./day
Chesley	200,000	114	1.080
Kincardine	470,000	120	3.020
Port Elgin	496,000 (11 mos.)	111	
Southampton	339,000	142	1.00
Walkerton	x 532,000	x 118	1.530
Wiarton	270,000	129	
Lion's Head	x 56,000	x 118	0.024
Lucknow	94,200	86	0.490
Mildmay	x 117,000	x 118	0.024
Paisley	x 108,000	x 118	0.095
Ripley	x 64,000	x 118	0.350
Tara	x 78,000	x 118	0.129
Teeswater	x 117,000	x 118	1.150
Tiverton	x 94,000	x 118	0.068
Total	3,035,200		5.087

x - Estimated

INFORMATION ON WATER SOURCES

The following information on deep wells and other sources of supply is made available through the local water works systems and the publications of the "Ministry of the Environment - Ground Water in Ontario".

These public water works systems are included in the Bruce County information:

1. CHESLEY WATER WORKS SYSTEM

Source of supply is 2 wells, with storage in 2 elevated tanks of 360,000 gallons - 730 services.

Well #1 (Victoria Park Well) - 8" diameter, 119 feet deep and static level of 45 feet.
Well #2 (Community Park Well) - 13" diameter, and 66 feet deep.
Average daily consumption: 200,000 gallons

Analyses - April 30, 1974

	#1 Well	#2 Well
Hardness	276	284 ppm
Alkalinity	239	256
Iron (Fe)	< 0.05	0.05
Chloride	5	10
pH	7.6	7.6
Fluoride	1.0	0.1
Color	< 5	< 5
Turbidity	0.50	0.10

2. KINCARDINE WATER WORKS SYSTEM

Source - Lake Huron - filtration and chlorination - pressure filters - 450,000 gallons clear water reservoir at plant plus 175,000 gallon standpipe plus a new 475,000 gallon ground reservoir or a total storage of 1,090,000 gallons.
Average daily consumption (1974) - 470,000 gallons. Total flow (1974) - 166.863 mg. (January 1 to December 1) - maximum day 1.19 mg.

Analyses - Average for 1974

	Raw	Treated
Hardness	97	110 ppm
Alkalinity	81	84
Iron (Fe)	0.23	0.11
Chloride	6.3	8.0
pH	7.8	7.7
Color	2.5	5.8
Turbidity	5.8	2.1

3. PORT ELGIN WATER WORKS

Source - Lake Huron - filtration and chlorination - 100,000 gallon standpipe. Consumption -(January 1 to December 1, 1975) - total: 165.7 mg., maximum day, 1.8 mg., average day, 496,000 gallons.

Analyses - September 17, 1974 and February 27, 1975

	Raw	Treated
Hardness	116	126 ppm
Alkalinity	78	77
Iron (Fe)	0.05	0.03
Chloride	5.7	6.5
pH	8.0	7.6
SO_4	14.0	14.5
Color	< 5	< 5
Turbidity	5.4	0.25

4. SOUTHAMPTON WATER WORKS

Source - Lake Huron plus filtration and chlorination - Storage 100,000 gallon elevated tank plus a tank of 750,000 gallons. Filtration by 2 pressure diatomaceous earth filters for operation as required.
Water consumption: Total annual 124 mg., maximum day, 1.0 mg., average day 0.34 mg.

Analyses - 1974 average

	Raw	Treated
Hardness	107	115 ppm
Alkalinity	81	85
Iron (Fe)	1.05	0.12
Chloride	6.2	6.8
pH	8.1	8.1
Color	10.6	4.6
Turbidity	9.2	2.7
Fluoride	0.1	0.1

Southampton Water Works - continued

The water treatment plant, as of January 1, 1974, is operated by the Ontario Ministry of the Environment.

4. WALKERTON WATER WORKS

Source - 3 wells - treatment with silicate

Analysis

	#1 Well	
Hardness	1430	ppm
Alkalinity	210	
Iron (Fe)	0.2	
Chloride	5	
pH	7.2	

5. WIARTON WATER WORKS

Source - Colpoy Bay - sedimentation plus chlorination - Population 2,090. Open reservoir - 270,000 gallons Filtration to be provided - supply unmetered.

Analyses - July 10, 1974

	Treated	
Hardness	106	ppm
Alkalinity	74	
Iron (Fe)	< 0.05	
Chloride	6.0	
pH	8.1	
Color	< 5	
Turbidity	0.40	

6. LUCKNOW WATER WORKS

Source - 2 drilled wells, #4 and #5, depth 180 feet and 193 feet. 492 services - population: 1,114 - 160,000 elevated storage - no treatment.
Pumpage 1974 - total 34.4 mg., maximum day 0.223 mg., average day 0.094 mg., average month 2.865 mg.

Analyses - January 6, 1975

	#4 Well	#5 Well	
Hardness	246	234	ppm
Alkalinity	227	227	
Iron (Fe)	0.40	0.20	
Chloride	0.6	0.7	
pH	7.7	7.7	
Fluoride	1.6	1.6	
Color	10	< 5	

7. MILDMAY WATER WORKS

Source - wells (new well 1968 in use) - 10 " diameter, 114.5 feet depth, static level 3.56 feet above ground - 370 services - population 1,000 - standpipe 100,000 gallons

Analyses - August 26, 1974

	Main Pumphouse - New Well	
Hardness	300	ppm
Alkalinity	252	
Iron (Fe)	0.20	
Chloride	8.1	
Fluoride	0.1	
Color	< 5	
Turbidity	0.20	
SO_4	43.5	

8. PAISLEY WATER WORKS

Source - Teeswater River - 36,000 gallon settling tank plus filtration and chlorination.

Analyses - April 30, 1974

	Treated	
Hardness	230	ppm
Alkalinity	189	
Iron (Fe)	0.30	
Chloride	15	
pH	8.2	
Color	30	
Turbidity	6.4	

9. RIPLEY WATER WORKS

Ground supply - no treatment

Analyses -

Hardness	216	ppm
Alkalinity	170	
Iron (Fe)	.06	
pH	7.6	
Fluoride	1.0 (approx)	

10. TARA WATER WORKS

Source - 2 drilled wells - 125,000 gallon standpipe - 200 services
#1 well - 350 feet deep - chlorinated
#2 well - 389 feet deep - untreated

Analyses -

	#1 Well	#2 Well	
Hardness	300	300	ppm
Alkalinity	278	242	
Iron (Fe)	0.10	0.95	
Chloride	10	17	
pH	7.5	7.6	

Tara Water Works - continued

	#1 Well	#2 Well
Fluoride	1.0	1.2
Color	< 5	< 5
Turbidity	0.35	2.1

11. TEESWATER WATER WORKS

Source - well untreated - 348 services

Analyses - April 4, 1974

Hardness	282	ppm
Alkalinity	223	
Iron (Fe)	0.05	
Chloride	3	
pH	7.7	
Fluoride	0.3	
Color	5	
Turbidity	0.75	

12. TIVERTON WATER WORKS

Source - deep well (#4 or Dent) - depth 157 feet - 8" diameter
Chlorinated - 190 services
#1 Well - drilled - standby supply 239 feet, 6" diameter, static level 50
#2 Well - out of service
#3 Well - Noren well - to discontinue - depth 210 feet, 4" diameter,
Average daily flow from Dent well 23,100 gallons.

Analyses - July 2, 1974

	#4 Well	#3 Well	#2 Well	
Hardness	490	490	640	ppm
Alkalinity	90	89	89	
Iron (Fe)	0.35	0.35	0.20	
Chloride	10	10	11	
pH	7.9	7.9	7.9	
Turbidity	4.5	4.5	1.8	
SO_4	490	500	600	

PRIVATE WATER WORKS

1. ALBEMARLE TOWNSHIP
   Colpoy Bay Water Works

   Source - Colpoy Bay - settling tank of 600 gallons - Chlorination - 8 service connections

2. AMABEL TOWNSHIP

   Municipal agreement for a subdivision approved by Ministry
   120 gallon pressure tank

3. ARRAN TOWNSHIP

Burgoyne Water Association Water Works

Well - 284 feet - 17 services - no treatment

Analyses -	Well
Hardness	1680 ppm
Alkalinity	168
Iron (Fe)	6.5
Chloride	8.5
pH	7.4
Fluoride	0.8
Color	30
Turbidity	37
SO_4	1200

4. BRANT TOWNSHIP

Marl Lake Water Works

Owner: L. Redford Source: 2 wells (#1 and #2)

Elmwood Co-Op Water Works

Source - well, 100 feet, pressure tank 100 gallons - 12 services

Analyses - October 2, 1974	Well
Hardness	248 ppm
Alkalinity	257
Iron (Fe)	2.1
Chloride	4.0
pH	7.5
Color	10
Turbidity	10

Doersam Homes Water Works

Source - well

Analyses - June 11, 1974	Well
Hardness	296 ppm
Alkalinity	252
Iron (Fe)	$<$ 0.05
pH	7.6
Turbidity	0.10

5. BRUCE TOWNSHIP

Underwood Water Works

Source - well, 402 feet deep - 44 services - no treatment

Analyses - June 15, 1975

	Well	
Hardness	168	ppm
Alkalinity	107	
Iron (Fe)	0.15	
Chloride	9.5	
pH	8.1	
Fluoride	0.8	
Color	< 5	
Turbidity	5	
SO_4	165	

6. HURON TOWNSHIP

G. Elliott Water Works

Source - well, 189 feet deep, 6" diameter, rated 15 gpm
500 gallon pressure tank - no treatment - 55 services.

Analyses -

	Well	
Hardness	348	ppm
Alkalinity	180	
Iron (Fe)	0.26	
Chloride	5.5	
pH	7.66	
Fluoride	2.1	
Turbidity	1.6	
SO_4	180	

Huron Ridge Subdivision

Owner: H. J. MacGregor

Well - 191 feet deep, 5" diameter, rated 25 gpm pressure tanks
30 services.

Analyses - February 11, 1975

	Well	
Hardness	244	ppm
Alkalinity	140	
Iron (Fe)	0.15	
Chloride	8.5	
pH	8.1	
Fluoride	2.8	
Color	< 5	
Turbidity	0.80	
SO_4	175	

Huron Township - continued

Huron Township Subdivisions Water Works

Hemlock Hills Subdivision - 100 services, 92 lots (assumed by Township)

Source - well, 268 feet deep.

Analyses - January 1975

	Well
Hardness	536 ppm
Alkalinity	177
Iron (Fe)	1.3
Chloride	10
pH	7.8
Color	15
Fluoride	2.0
Turbidity	10
SO_4	325

Schiels Subdivision Water Works - (assumed by Township)

Source - well, 216 feet deep, 6" diameter, 68 services.

Analyses - January 1975

	Well
Hardness	556 ppm
Alkalinity	184
Iron (Fe)	1.8
Chloride	9.6
pH	7.6
Fluoride	2.2
Color	15
Turbidity	14
SO_4	345

Birch Acres Subdivision Water Works (assumed by municipality)

Source - well, 206 feet deep, 6" diameter, pressure tanks, 150 services.

Analyses -

	Well
Hardness	388 ppm
Alkalinity	188
Iron (Fe)	0.40
Chloride	7.9
pH	7.6
Fluoride	2.2
Color	5
Turbidity	3.5
SO_4	184

Huron Township - continued

P. V. Smith Subdivision Water Works (assumed by municipality)

Source - well, drilled 230 feet, 4" diameter, pressure tanks, no treatment - 50 services.

Analyses - February 1975

	Well
Hardness	1070 ppm
Alkalinity	153
Iron (Fe)	0.95
Chloride	84
pH	7.5
Fluoride	2.2
Color	5
Turbidity	4.3
SO_4	540

Bonnie Brae Subdivision Water Works (assumed by Township)

Source - well, 274 feet deep 5" diameter, pressure tanks, 35 services.

Analyses - February 1975

	Well
Hardness	292 ppm
Alkalinity	176
Iron (Fe)	0.95
Chloride	44
pH	8.3
Fluoride	2.2
Color	15
Turbidity	8.8
SO_4	175

7. KINCARDINE TOWNSHIP

Lake Huron Highlands Subdivision Water Works

Source - well, 141 feet deep, 6-1/2" diameter, pressure tanks, 44 services.

Analyses - April 23, 1975

	Well
Hardness	290 ppm
Alkalinity	229
Iron (Fe)	0.20
Chloride	6.0
pH	7.8
Fluoride	1.5
Color	5
Turbidity	1.9
SO_4	36.5

8. KINLOSS TOWNSHIP

Hilray Farms Water Supply

Source - well, 217 feet deep, 5" diameter, 7 services

Analyses

	Well
Hardness	286 ppm
Alkalinity	209
Iron (Fe)	0.30
Chloride	90
pH	7.5
Fluoride	0.9
Color	< 5
Turbidity	2.5
SO_4	93

Whitechurch Water Works - Source - well

Analyses - January 14, 1975

	Well
Hardness	264 ppm
Alkalinity	247
Iron (Fe)	0.70
Chloride	9
pH	7.9
Fluoride	0.5
SO_4	13.5

Bannerman Water Works - Source - well - 6 services

Analyses - January 15, 1975

	Well
Hardness	226 ppm
Alkalinity	208
Iron (Fe)	0.6
Chloride	90
pH	8.0
Fluoride	1.0
SO_4	60

9. LINDSAY TOWNSHIP

Miller Lake Estates Tent & Trailer Park Water Works

Source - well - 65 sites - no analyses

Summerhouse Park Trailer Camp Water Works

Source - spring, 1000 gallon reservoir, chlorination, pressure tank.

Lindsay Township - continued

Summerhouse Park Trailer Camp Water Works - continued

Analyses - September 26, 1974

Hardness	148 ppm
Alkalinity	126
Iron (Fe)	0.05
Chloride	7.0
pH	8.7
Color	< 5
Turbidity	1.7

10. ST. EDMUNDS TOWNSHIP

Lands End Trailer Park Water Works - data lacking

WATER ANALYSES

Analyses by the Ontario Water Resources Commission (now the Ministry of the Environment) of municipal water supplies are given previously in this appendix. How do these figures compare with desirable or permissible standards? Emphasis has been placed, more so in recent years, on figures which can be considered as safe for domestic consumption and other uses, as well as desirable limits. The latter are intended for a good water supply, one which will be palatable and convenient for use in all aspects.

Guidelines or objectives for drinking water supplies have been adopted by a number of agencies. In Ontario, the government figures have been selected. They are subject to change from time to time as more information becomes available. These figures are given in the body of this report. Two classifications may be accepted, one as permissible or safe standards, the other as desirable. The latter are used for comparison with the results of the analyses for the various public supplies.

The following comments are offered on these supplies.

Bacteriological analyses are not noted, since means are readily available to ensure the desired results.

CHESLEY:

The chemical analyses for the two wells show the hardness to be approximately 280 ppm, a figure much higher than the desirable limit generally used.

The fluoride contents of 0.1 for #2 well and 1.0 for the second well are interesting. The low figure is of no value while the other, #1 well, is exactly the figure accepted generally as desirable and beneficial.

Nothing else is evident in the analysis of these well waters.

KINCARDINE:

The chemical analysis of this lake supply reveals a much lower figure for hardness, 100 ppm approximately.

While the iron content is acceptable it would not be expected to be this high. There is some color, but not objectionable. The turbidity of the raw water at the time of sampling was reasonable, but a desirable supply for drinking water should be virtually zero.

PORT ELGIN:

This lake supply may be compared with that for Kincardine. The raw lake water depends on the condition at the time of sampling and this may vary a good deal.

The figure for hardness is somewhat higher. The iron is much lower and well within limits. Turbidity, as might be expected, showed in the range for lake supplies. This can be readily reduced by filtration.

SOUTHAMPTON:

This lake supply is much like the others except that the iron in the raw water was 1ppm, an unexpected high. The turbidity at 9.2 was reduced to 2.7 in the treatment. The fluoride of 0.1 ppm was insignificant.

WALKERTON:

Supply from 3 wells

High hardness.

WIARTON:

A surface supply from Colpoy Bay - another lake supply which can be maintained in safe condition by treatment. The chemical analysis is much like the other waters for Bruce County coming from the lake.

HEPWORTH:

This smaller community is supplied with ground water. The chemical analyses show a distinct difference from the lake supplies. The hardness is high at 250 to 300 ppm. The iron content of more than 1 ppm is beyond the desirable limit. Also the chloride figure at 100 in #1 well is high but not unacceptable. The fluoride at 0.6 ppm is below the desirable limit of 1 ppm. Similarly the color of 40 and 20 is objectionable. The turbidity at 41 in #1 well is also objectionable.

LION'S HEAD:

A small community with water from the lake and analyses similar to others from a similar source. Most small centres cannot put in expensive systems of treatment. The measures aim at safety.

LUCKNOW:

Another ground water supply, with the chemical content much higher than in surface waters. The hardness of both wells #4 and #5 in the area of 250 ppm is objectionable. Iron is present although not excessive. The fluoride figure is beneficial against tooth decay. The color in #4 well at 10 is undesirable.

MILDMAY:

Another inland ground water with a hardness of 300 mg/l. The fluoride is insignificant.

PAISLEY:

This surface supply from the Teeswater River has a higher chemical content than might be expected - 230 mg/l in the treated water. The iron at 0.30 is also more than desirable. The color at

30 units did not show effective treatment. The same may be said about the turbidity. Samples on this source can be expected to vary. It is apparent that persistent effective treatment is needed.

RIPLEY:
This is a ground water supply with no treatment.

TARA:
This well water from a deep source is high in chemicals - hardness 300, alkalinity 278 and iron in #2 well at 0.95. The fluoride at 1.0 and 1.2 is at the desirable limit.

TEESWATER:
An untreated ground water is hard at 282 mg/l., and alkalinity at 223. Other figures are low.

TIVERTON:
This ground water supply from 4 wells and analyses from 3 wells. #4 well from which most water is withdrawn is quite hard at 490 mg/l., so also is the SO_4 content of 490, and rising to 600 in #1 well. This water needs softening and iron removal.

PRIVATE WATER WORKS

Many water works systems in Bruce County are privately owned and operated. Some are quite small, and most are limited in capacity. The analyses of these waters are of interest, especially of the chemical contents. Some examples may be cited.

Arran Township - Burgoyne Water Works

The hardness of 1680 mg/l and iron of 6.5 make this an unattractive water for drinking purposes. The SO_4 content of 1200 is much beyond the desirable limit.

Brant Township - Hardness 248 and alkalinity 257, iron 2.1, color 10 - an unattractive supply.

Bruce Township - Underwood Water Works

Has a hardness of 168 and fluoride of 0.8 - not greatly out of line.

Huron Township - Elliott Water Works

The high hardness of 348 and fluoride of 2.1 are to be noted.

Huron Ridge Subdivision - is a hard water, 224 mg/l., and fluoride of 2.8

Hemlock Hills Subdivision - The well 268 feet deep shows 536 mg/l. hardness, iron 1.3, fluoride of 2.0 and SO_4 of 325 all make this undesirable.

Schiels Subdivision - of the township with water from a deep well gave a hardness of 556, iron 1.8, fluoride 2.2 and SO_4 of 345 - a highly mineralized supply.

Similarly the Birch Acres Subdivision water supply showed a hardness of 388, iron 0.4, fluoride 2.2.

P. V. Smith Subdivision - uses water from a well 230 feet deep. The hardness was very high at 1070, iron 0.95, fluoride 2.2, and SO of 540 - all high figures.

Bonnie Bray Subdivision - in the same township gave a high hardness of 292, iron 0.95, and fluoride of 2.2.

Kincardine Township - Lake Huron Highlands Subdivision

Showed well water of 290 hardness, alkalinity 229, and fluoride 1.5.

Kinloss Township - with three private systems all showed the presence of more than desirable chemicals.

SUMMARY OF ANALYSES

In general the ground waters of Bruce Township are unfavorable due to high figures for hardness, SO_4, and iron. Fluoride content was elevated in many of the well waters. The desirable limit of 1.0 mg/l. has a distinct advantage, but where the figure is high, some mottling of the tooth enamel must be expected.

The privately owned systems have the most difficulties in meeting desirable chemical standards.

GROUND WATER ELEVATIONS

Static water levels for the drilled wells are recorded in the data published by the Province, so also is the ground elevation at the well. The latter is in relation to the mean sea level (MSL).

To convert the water level to the MSL base, subtract the static level in the well from the ground surface level. This places all wells on a common base. The result also shows the head available between the water in the well and the sea level. The ultimate outlet is the ocean. At any rate, the fall for this journey is available. How much of the precipitation that reaches the sea is not given.

OBSERVATION WELLS

It is always desirable to know the state of the bank account. The underground reservoir as a bank account has its credits and debits. Is the water level receding or rising? Means must be available to have this information continually.

Observation wells, as the name implies, record the static water levels. They are an important means of securing information on what is taking place. Other readings also supplement these data.

Modern observation wells are equipped with mechanism for continuous recording of the levels. This information accumulates and shows what the long term performance is for that well.

POLLUTION STATUS OF GROUND WATER

At this time there is no indication of surface pollution finding its way into the deep aquifers. This should not be taken too conclusively. It is important to dispose of all wastes at the surface so that the ground water will be protected and its quality preserved. Periodic checks should be carried out as a conservation measure.

Since pollution must include natural and man made substances, consideration needs to be given to the chemical figures. These are not subject to the same rapid fluctuations as biological material. Comments have been made on these chemicals in the various waters. There is not enough long-time data to determine whether these figures are changing. Continuing programs of sampling and analyses are desirable.

SUMMARY AND CONSLUSIONS

COUNTY OF BRUCE

GROUND WATER COUNTY OF BRUCE

The following observations are based on information secured from several sources, with related interpretations.

(1) The records of wells, water resources, water quality and purification, and adequacy of supplies for the County's needs have been examined.

(2) Attention has been directed particularly to municipal or public, industrial, and private water supplies, as the largest consumers from specific points.

(3) Since there is no city in the county there is no major population at one point. In contrast to this is the proximity of Lake Huron for use as the need arises.

(4) The municipal water works systems serve a total population of 25,573 with an annual consumption of over 3 million gallons per day. The municipalities of Chesley, Walkerton, Lucknow, Mildmay, Ripley, Tara Teeswater and Tiverton use ground water for their public supplies. The population of these centres is nearly 48.8% of the total of these systems.

(5) The rated capacity of these ground water systems is listed as 5.087 million gallons per day, and the estimated withdrawal from the same wells was 1.3 million gallons per day. The total water withdrawal, surface and ground water was 3 million gallons per day.

(6) Rural areas usually rely on wells and drilling is the usual practice. No great difficulty seems to have been experienced in getting enough water. This should be the case for many years ahead.

(7) Because of the nature of the overburden and bedrock, the chemical content of the water is often quite high.

(8) The presence of fluoride is natural in a number of the public supplies derived from ground water. The beneficial amount is 1.0 mg/l with variations above and below that figure. Huron Township privately operated systems have several with the amount of 2.0 or near this.

(9) There is no evidence as yet of man-made chemical pollution in the deep wells. Care will be needed to portect against this danger, and periodic examinations should be made for detection of such substances.

(10) The tabulation of wells, the drilling of which are on file with the Province shows a total of 2,887 for a total population of 52,313, or about one well for 18 persons, including both urban and rural. This can be considered only as a rough figure. It is interesting that the high percentage of these (95) was in bedrock and that about the same percentage gave fresh water.

(11) The legislation for the control of water resources, largely provincial measures, has stood the test of time, with amendments to keep it up-to-date.

(12) Conservation of ground water is essential to those areas which must rely on this source.

A P P E N D I X

2

COUNTY OF ELGIN

GROUND WATER IN SOUTHWESTERN ONTARIO

- A REPLENISHABLE RESOURCE -

1 9 7 7

CONTENTS

COUNTY OF ELGIN

COUNTY OF ELGIN

The lakeshore County of Elgin has always been a prominent part of Southern Ontario. The city of St. Thomas has been a focal point for many activities. The southern exposure creates a favourable climate, combined with rich agricultural land for a propserous and aggressive section. Under such conditions, water is preeminent. Surface and ground waters are needed to aid domestic pursuits and industry.

THE COUNTY

The area of the County is 698,682 acres as compared with its neighbours, Kent at 586,613, Oxford at 485,333, and Middlesex at over 788,000. The total population of 64,562 is nearly 40% in St. Thomas, 18% in towns and villages, and 42% rural in the townships.

Access to the waterfront no doubt influenced early development in the County. Proximity to any navigable water always was beneficial, in the early days, for transportation and later for many other uses of water.

DRAINAGE OF THE LAND

Drainage of the land is made possible by a number of creeks emptying into Lake Erie. Conspicuous among these are Kettle Creek through St. Thomas, Big Otter Creek from Tillsonburg, and Catfish Creek discharging at Port Bruce. Conservation Authorities operate on Kettle Creek and Catfish Creek. There is extensive overburden to absorb the precipitation and provide water reservoirs.

GEOLOGY OF THE COUNTY

Information is available on the geological formations under the County.

A large section of the area is listed as Dundee Formation: medium or light brown limestone. The Marcellus Formation with black bituminous shale and minor limestone occupies a good portion between Big Otter Creek and Talbot Creek. The Hamilton Formation of grey shale, argillaceous and crinoidal limestone, is found in the western part of the County.

The effects of these formations on the quality of the ground water will be important. In much of the County the total hardness content is high, so also is iron. The presence of fluoride in beneficial amounts is noted in the deep aquifers but much less in the shallow waters. There is, as must be expected, a substantial difference in the mineral contents of the waters of the deep and shallow aquifers. The results will be found to be quite variable.

Conservation measures will be of concern not only to store water from too rapid runoff and to maintain the best quality.

INDUSTRIAL NEEDS

Industrial operations must be assured of adequate water supplies of good quality. Since most industries tend to concentrate in the larger urban centres, it will not be expected that large quantities of water are likely to be needed in places with smaller populations. St. Thomas derives water now from Lake Erie.

It is important in planning for future water needs that due weight be given to agricultural needs and to smaller industries which might operateat small centres. Both of these might well be supplied from ground water.

RURAL WATER SUPPLIES

The populations in rural areas rely for the most part on wells, either dug or drilled. This generally ensures protection against sur-

face pollution and an economical supply for most uses. The first requirement must be to obtain a sufficient quantity of water. One of the risks from the shallow well is lack of water in dry periods.

To what extent will irrigation of crops in this County be widely used in the future is a question. Some crops depend largely on irrigation to carry them over the periods of low precipitation. Future planning will need to give attention to the availability of water for this purpose. Well water may be important.

WELL DRILLING RECORDS

The following data show some of the characteristics of some of the larger drilled wells in the County. Most of them are for rural use. The table shows only the more significant wells to indicate conditions in general.

ALDBOROUGH TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (inches)	Depth	Static Level	Rated gpm	Water Formation
Elgin Petroleum Corporation	5	4	5	199	90	35	
do	5	4	9	188	93	130	
Canada Cities Service	5	5	10	241	84	240	
Ingratta Bros.	11	13	5	183	45	60	
P. Palenkas	4	18	6	246	10	25	
Can.Kewanee Ltd.		1	10	241	76	195	
BAYHAM TOWNSHIP							
Dept.Lands & Forests	1	10	2	21	3	30	
J. Jager	8	19	8	280	72	30	sulphur
R. Carson	9	24	5	76	52	25	
F. Goncz	10	24	8	103	72	200	
DORCHESTER SOUTH TOWNSHIP							
E. Christian	7	12	6	120	11	20	

DUNWICH TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (inches)	Depth	Static Level	Rated gpm	Water Formation
P. Smith	7	8	4	281	48	25	
Dept.Hwy.Ontario	7	10	6	282	95	25	
P. Hentz	9	11	4	224	95	240	

MALAHIDE TOWNSHIP

Aylmer P.U.C.	7	15	26	82	8	500	
J. Fehr	4	16	36	41	22	50	
Many small, low capacity wells by Aylmer P.U.C.							
Aylmer P.U.C.	8	21	2	146	5	30	
do	8	27	2	132	Flow	60	
Carnation Milk Co.	9	17	10	238	26	250	sulphur
do	9	17	8	235	25	200	sulphur
J. Walker		98	5	169	58	30	

SOUTHWOLD TOWNSHIP

S. Segal		45	5	105	15	50	
Dept. Transport		11	14	273	63	118	
Ford Motor Co.		47	6	279	-	Dry	
H. Foster	2	16	5	230	13	20	

YARMOUTH TOWNSHIP

St. Thomas Golf Club	3	2	8	233	1	180	
do	3	2	13	222	Flow	85	
C. Crevits	3	4	2	35	5	42	
J. Everatt	4	6	5	242	26	37	
do	4	8	6	53	Flow	45	
C. Hindley	4	20	4	46	15	30	
P. Dennis	6	1	1	181	8	150	
Dept. Transport	8	62	14	117	57	100	
C. Ferguson	11	8	4	66	18	25	
PUC ST. Thomas	1	4	16	113	Flow	320	
do		58	12	185	60	550	

ST. THOMAS CITY

P.U.C.			6	304	-	Dry	
Several others - dry.							

AYLMER TOWN

Dept. Transport	# 77		14	70	22	92	
Aylmer	# 75		24	212	45	200	
do			26	218		250	

BELMONT VILLAGE

Village	# 663		8	170	25	75	
do	#1938		10	147	5	50	
Borden Co.	#1263		10	114	28	427	

PORT BURWELL VILLAGE

OWNER		Con No.	Lot No.	Dia. (inches)	Depth	Static Level	Rated gpm	Water Formation
P.U.C.	# 597			6	14	1	42	
do	# 616			2	13	6	64	

VIENNA VILLAGE

OWNER		Con No.	Lot No.	Dia. (inches)	Depth	Static Level	Rated gpm	Water Formation
J. Pettie	# 961			6	200	6	50	sulphur

SUMMARY

ELGIN COUNTY WELL DATA

Total Wells Drilled 2,106

Ending in: Overburden 1,930
Bedrock 171

Kinds of Water:
Fresh. 1,800
Salt 2
Sulphur 89
Mineral 9
Dry hole 131

Water Use:
Domestic or stock 1,649
Irrigation 84
Industrial 26
Commercial 51
Municipal 11
Public supply 67
Cooling - Air cond. . . . 1
Not used 92
Test hole 98
Abandoned 190

WATER USE DATA

Information has been collected on water use, and particularly ground water. These data are tabulated herein, and interpretation of the data has been made and recorded.

PUBLIC WATER WORKS SYSTEMS

MUNICIPALITY	DATE Constructed	POPULATION SERVED	WATER SOURCE
St. Thomas	1890	26,853	Lake Erie
Aylmer	1886	5,030	Wells
Belmont		745	Wells
Dutton		990	Lake Erie
Pt. Burwell		160	Lake(area)
Pt. Stanley	1913	1,616	Lake Erie
Rodney		943	Lake Erie Supply
West Lorne		1,136	Lake Erie
Yarmouth			Lake Erie

The Elgin area system draws water from the lake for municipalities.

Surface waters are in general use in all these municipal systems since there is ready access to the lake.

WATER CONSUMPTION

A feature of importance in water consumption is the variation in demand, as well as changes in the precipitation. In times of drought there may be heavy calls on reservoirs. The rate of consumption may also vary considerably, influenced by seasons of the year and other factors. Hence, there needs to be a wide spread in total rainfall and total consumption.

INFORMATION ON PUBLIC WATER SYSTEMS

The following information on deep wells and other water sources is made available from the local water works systems and the publications of the "Ministry of the Environment - Ground Water in Ontario".

The following public water works systems are in operation in Elgin County:

(a) ST. THOMAS - ELGIN AREA

The supply is derived from Lake Erie via the St. Thomas - Elgin Area water supply system.

Water was formerly secured for St. Thomas from Kettle Creek and a well. Water purification works included filtration and Chlorination. The local system of distribution is administered by a public utilities Commission. This lake supply is filtered and chlorinated.

Analyses -

Hardness	130
Alkalinity	87
Iron (Fe)	0.05
Chloride	22
Fluoride	1.1
Colour	0
pH	7.5

(b) AYLMER WATER WORKS

Source of supply wells - No. 1 and No. 3A

Analyses - February 11, 1974 - raw water

	Well No. 1	Well No. 3A
Hardness	72	176
Alkalinity	192	195
Iron (Fe	0.10	0.45
pH	8.2	7.9

(c) BELMONT WATER WORKS

Source - 2 drilled wells - 10" diameter, 135 ft. depth - reservoir 55,000 gallons.

Analyses

Hardness	174
Alkalinity	191
Iron (Fe)	0.35
Chloride	4
Fluoride	0.7
pH	7.8

(d) DUTTON WATER WORKS

Lake Erie Supply from West Lorne supply works.

(e) PORT BURWELL WATER WORKS

Source - area scheme supply from lake.

(f) PORT STANLEY WATER WORKS

Lake Erie supply with filtration and chlorination

(g) RODNEY WATER WORKS

Lake Erie Supply from West Lorne supply works.

(h) WEST LORNE WATER WORKS

Lake Erie supply - Filtration anc chlorination - force main to centre of municipality and to other communities or Rodney and Dutton.

Analyses

Hardness	136
Alkalinity	88
Iron (Fe)	0.05
Chloride	23
Turbidity	1.3
pH	7.5

PRIVATELY OPERATED PUBLIC SYSTEMS

The following information is noted on privately owned and operated water works in the County. Such systems supply only a limited population, and are usually an extension of a system created for a single dwelling or commercial plant.

ALDBOROUGH TOWNSHIP

Port Glasgow - W. B. Baxley Cottage Supply - source, Lake Erie, filtered and chlorinated - 80 trailer units.

Analyses - July 27, 1972

Hardness	156
Alkalinity	114
Iron (Fe)	0.05
Chloride (Cl)	24
pH	7.8
Color	< 5
Turbidity	1

BOYHAM TOWNSHIP (summer supplies)

Red Oak Trailer Park - well 6", 79 ft. deep - 50 tent and trailer sites.

Analyses - July 8, 1975

Hardness	312
Alkalinity	285
Iron (Fe)	0.24
Chloride (Cl)	1.5
pH	7.58
Color	< 5
Turbidity	1.6

Erie-Vu Trailer Park Water Works - source - well

Analyses -

Hardness	316
Alkalinity	285
Iron (Fe)	1.2
Chloride	19
Fluoride	0.1
SO_4	- 49

Carson Mobile Home - source - well

Analyses

Hardness	484
Alkalinity	252

Carson Mobile Home - continued

Iron (Fe)	0.10
Chloride (Cl)	144
pH	7.6
Fluoride (Fl)	0
Total solids	900

Village of Richmond - Lots 111 and 112, Con. South Gore.

3 springs to a shallow well - 25 services.

Analyses - May 15, 1974 - Pumphouse Well

Hardness	312
Alkalinity	194
Iron (Fe)	0.15
Chloride(Cl)	37
pH	7.8
Fluoride (Fl)	0

DORCHESTER SOUTH TOWNSHIP

Alex McNeil Trailer Court Water Works - 2 wells to underground storage - 111 persons.

Analyses - April 25, 1975.

Hardness	148
Alkalinity	178
Iron (Fe	0.2
Chloride (Cl)	1
pH	8.2
Fluoride	1.2
Color	< 5
Turbidity	1.4
SO_4	- 90
Na	23
K	1.2
Nitrate	0.16

DUNWICH TOWNSHIP

Dutton Beach Water Works - trailer park. Well - 160 ft. deep, - 102 trailer outlets plus 5 cottages.

Analyses - July 17, 1973

Hardness	148
Alkalinity	176
Iron (Fe)	0.2
Chloride (Cl)	22
pH	7.7
Fluoride (Fl)	1.4
Color	< 5
Turbidity	2.2
SO_4	-60

MALAHIDE TOWNSHIP

Angus Hugh's Water Works, source - sand point well, chlorinated, 6 services.

Analyses - July 16, 1970.

Hardness	16
Alkalinity	220
Iron (Fe)	0.05
Chloride (Cl)	26
pH	8.2

Windgate Lodge Water Works, source - sand points and infiltration well chlorinated - 26 services

Analyses - July 20, 1971.

Hardness	324
Alkalinity	242
Iron (Fe)	1.8
Chloride (Cl)	47
pH	7.6

Mechas Trailer Park Water Works - well 21 ft. depth, stat. level 12-14 ft., 250 gal. storage tank - chlorinated - 150 tent and trailer sites.

Analyses

Hardness	830
Alkalinity	401
Iron (Fe)	0.1
Chloride (Cl)	160
pH	7.1

Big Six Trailer Park Water Works - shallow well - 10 trailers (chlorinated)

Analyses - September 6, 1973

Hardness	400
Alkalinity	387
Iron (Fe)	2.3
Chloride (Cl)	72
Fluoride	0.1
pH	7.1
Color	70+
Turbidity	23

Waneeta Beach Water Works - sand point, 17 services

Analyses - August 20, 1972.

Hardness	212
Alkalinity	180
Iron (Fe)	0.05
Chloride (Cl)	23
pH	8.0

MARMOUTH TOWNSHIP

Pol Subsidivion Water Works - well, 155 ft. deep, to reservoir 19,000 gal.

Analyses - February 28, 1974.

Hardness	44
Alkalinity	134
Iron (Fe)	0.05
Chloride (Cl)	3
pH	8.3
Fluoride	1.8
Color	5
Turbidity	0.45

WATER ANALYSES

The Ministry of the Environment for the Province has classified wells into deep, intermediate, and shallow aquifers. The deep well water might be expected to contain more chemicals, such as hardness, iron, fluoride, and total dissolved solids. But the averages for the constituents as shown for the deep, intermediate and shallow aquifers do not bear this out.

Chemical compositions for some series of wells (ppm):

Substance	Deep Aquifer	Intermediate Aquifer	Shallow Aquifer
Hardness			
a) Average	177	136	292
b) Limits	58-424	34-336	48-460
Total Dissolved Solids			
a) Average	560	287	474
b) Limits	160-1064	130-490	242-950

Water Analyses continued

Substance	Deep Aquifer	Intermediate Aquifer	Shallow Aquifer
Iron (Fe)			
a) Average		0.89	0.75
b) Limits	0.05-36.0	0.10-3.9	0.05-4.40
Fluoride			
a) Average	1.0	1.0	0.45
b) Limits	0.1-1.9	0.1-1.4	$<$ 0.1-0.9

GROUND WATER ELEVATIONS

Static water levels for the drilled wells are recorded in the well data published by the Province, so also is the ground elevation at the well. The latter is in relation to the mean sea level (MSL).

To convert the water level to the MSL base, subtract the static level in the well from the ground surface level. This places all wells on a common base. The result also shows the head available between the water in the well and the sea level. The ultimate outlet is the ocean. At any rate the fall for this journey is available. How much of the precipitation that reaches the sea is not known.

OBSERVATION WELLS

A number of ways are used to record the water levels in the aquifers. Continuous records are available in a number of observation wells maintained by the Province. Well drilling records also give the water level in the finished well at this one time. Levels may be recorded also by some water departments and by other observers. All of these are useful.

Modern observation wells are equipped with mechanisms for continuous recording of the levels, thus enabling information to be secured on the water level trends over a prolonged period.

In Elgin County only one observation well is maintained by the Province. This is No. 187 in Bayham Township, lot 22, Conces-

sion X, in the drainage area of the Big Otter Creek. It is equipped with an automatic recorder since 1965, The depth of the well is 17.5 feet. The chart does not show any trend other than small variations up and down.

POLLUTION STATUS OF GROUND WATER

At this time there is no indication of serious surface pollution finding its way into the deep aquifers. It must be pointed out, in spite of this, that it is important to destroy and to dispose of all wastes at the surface so that the ground water will be protected and its quality preserved. Periodic checks should be carried out. This is conservation in a profitable way.

SUMMARY AND CONCLUSIONS

GROUND WATER COUNTY OF ELGIN

The following observations are based on information secured from several sources, with related interpretations.

(1) The records of wells, water resources, water quality and purification, and adequacy of supplies for the County's needs have been examined.

(2) Attention has been directed, particularly to municipal or public, industrial, and private water supplies, as the largest consumers from specific points.

(3) The focal point for water consumption in the County is the City of St. Thomas. The selection of Lake Erie as the source ensures an adequate quantity for future growth and all water uses.

(4) The municipal or public water works systems serve a total population of approximately 39,000, with an annual consumption estimated at 1.401 billion gallons. The municipalities of Aylmer and Belmont use ground water for their public supplies. This is 15% of the total population of these centres.

(5) The annual withdrawal of ground water for these public systems was estimated at 600,000 gallons. When to this is added the withdrawal from wells for private use, it will be seen that a substantial reservoir is needed to balance the supply and demand.

(6) Rural areas must rely chiefly on wells now developed by drilling. No great difficulty seems to have been experienced in

Summary and Conclusions continued

getting enough. The chemical content of the water is often quite high but not sufficient to exceed the limits generally prescribed for domestic use.

(7) The presence of fluoride in the deep well waters averages one ppm, the amount considered best for the protection of teeth.

(8) There is no evidence as yet of man-made chemical pollution of deep wells. Care will be needed to protect against this danger, and periodic examinations should be made for detection of any such substances.

(9) The legislation for the control of water resources, largely provincial measures, must be considered to be satisfactory.

(10) Conservation of ground water is essential in those areas where deep wells are used.

(11) The use of ground water in the County is shown by the tabulation of well drillings prepared by the Ministry of the Environment. This is being added to regularly and these records will continue to serve a most useful purpose.

APPENDIX

3

COUNTY OF ESSEX

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

1 9 7 7

CONTENTS

ESSEX COUNTY

ESSEX COUNTY

Bounded on two sides by the waters of the Detroit River and Lake Erie lies the attractive and flourishing County of Essex. How are its water needs being met? Must the future be in ground water or surface supplies? Whatever direction is followed, water will play a key role. Its distribution in piped supplies to all premises should be the constant objective.

1. THE COUNTY

The County, in general, is a flat plain. The soil is fertile, and the County is a good agricultural area. While many wells have been sunk, the municipal or public water supplies are now coming from surface sources. Industry plays an effective role in the well-being of the area.

The total population of the County (1973) was given as 304,135, of which 234,363 was in the urban centres. The townships had a total population of 69,772 or 23% of the total County. The urban total may be compared with the rural figure, yet in a County so industrialized as this, it is not easy to show a clear line between the two.

The total area of the County is 460,108.8 acres. The total equalized assessment in 1975 was $3,063,078,000 for general purposes. The assessment was $9,870 per capita.

2. DRAINAGE OF ESSEX

This County is unique in that it is at a low elevation, and has a flat surface. Drainage outlets are more difficult and are influenced by the water levels in Lake Erie and in the Detroit River.

While this may be a surface problem, it should permit maximum seepage into the underground and favorably influence ground water. Yet this is not a County which has a favorable ground water reservoir for domestic waters. Municipal water works derive their supplies from the surface. Where ground water can be tapped it is likely to contain chemicals difficult to remove.

3. GEOLOGICAL FORMATIONS

This geological formation in the County has a direct influence on both the quantity and quality of the ground water.

The whole County, with a small exception, is underlain by rocks of the Middle Devonian Age. There is much limestone and dolomite. Since so many wells are in rock formations this will influence the water quality as will also the overburden. The quantity in most parts of the County is sufficient for agricultural and related needs.

The County is well served by public or municipal water works systems, as will be listed later. Such a distribution of piped water to so large an area brings with it a strong factor in the protection of public health and the general welfare of the population. For some time now, these municipal systems have been extended beyond the urban boundaries.

4. INDUSTRIAL WATER NEEDS

Industrial operations, as well as domestic demands, require large amounts of water always available at convenient outlets.

The records of well data show some wells of good volume. These could be satisfactory if the locations are suitable for industrial plants. Much of the water contains sulphur and is mineralized. The trend for municipal use has been to surface supplies, and former municipal wells are not now used for that purpose.

Reference might be made to some high capacity wells.

(1) In Colchester Sth Twp. - 8" well, drilled for J. Cairreara-

300 gpm
-8" well drilled for K. Mullard - 420 gpm
-8" well drilled for Experimental Farm - 300 gpm.

(2) In Gosfield South Twp. -

-8" well drilled for H. Peterson - 300 gpm
-8" well drilled for A. Fox - 400 gpm

(3) In Mersea Twp.-

-8" well drilled for D. McCarthy - 300 gpm
-8" well drilled for J. Toews - 333 gpm
-8" well drilled for N. Maynard - 300 gpm
-8" well drilled for C. Prenton - 600 gpm but sulphur and minerals

(4) In Windsor City

-10" well drilled for General Foods - 450 gpm but sulphur and mineralized

(5) Rural Water Supplies

Rural wells supply much of the County's water needs. The following data show the characteristics of some of the larger wells. The analyses of these well waters are not listed, but many of them have been examined by the Ontario Water Resources Commission (now the Ministry of the Environment). In general, they are quite hard waters, many contain sulphur and minerals, some are salty. Many of these would not meet the standards set by health agencies for domestic supplies. The current studies of the relationship between hardness and coronary diseases are of interest in this County.

ANDERDON TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (Inches)	Depth	Static Level	Rated gpm	Water Formation
Church & Dwight Co.	1	2	6	53'	28'	50	
C. Sooley	1	1					
McGregor Water System	8	12	8	91'		30	
do	8	12	8	92'	18'	50	

COLCHESTER NORTH TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (Inches)	Depth	Static Level	Rated gpm	Water Formation
T. Thoman	6	3	8	102'	15'	45	sulphur water

A number of sulphur wells in the township

COLCHESTER SOUTH TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (Inches)	Depth	Static Level	Rated gpm	Water Formation
J. Simoes	2	12	8	115'	17'	30	
P. Fox	2	18	7	76'	15'	30	
A. Wilson	3	16	3	43'	6	60	
J. Turnbull	4	17	8	35'	8'	33	
D. Hernandes	5	7	4	89'	7'	65	
A. Beswick	FC	40	6	65'	1'	50	sulphur
H. Wright & Son	FC	51	8	325'	28'	80	
Can.Agric.Research Station	FC	51	3	23-42'	10'	25	6 wells of same nature
J. Cairreara	FC	52	8	288'	28'	300	
do	FC	52	8	232'	28'	88	
K. Butler	FC	54	3	124'	17'	30	
K. Mullard	FC	57	8	465'	10'	420	sulphur
O. Mills	FC	59	3	145'	27'	225	
J. Pigeon	FC	89	4	80'	13'	40	
M. Matos	Gore	7	8	115'	18	40	
M. Pohanka	Gore	11	4	116'	11'	34	sulphur
Dominion Science Lab.	Gore	21	10	30'	14	80	
W. Stadon	Gore	14	8	225'	14'	175	
Dominion Exper. Lab.	Gore	15	8	129'	10'	300	
J. Murray	Gore	16	8	190'	15'	165	
do	Gore	16	8	144'	26'	60	
Harrow Res.Stn.	Gore	17	8	372'	28	50	
H. Lepp	Gore	17	8	130'	18'	65	sulphur
A. Herniman	Gore	18	7	106'	7	65	

GOSFIELD NORTH TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (Inches)	Depth	Static Level	Rated gpm	Water Formation
E. Ross	6	5	3	110'	16'	33	
J. Fox	7	21	4	132'		83	
G. Simpson	TRS	266	5	116'	6'	50	
Essex City Canners	TRS	275	6	150'	31'	70	

GOSFIELD SOUTH TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (inches)	Depth	Static Level	Rated gpm	Water Formation
P. Wenzler	2	8	8	186'	12'	67	
H. Peterson	2	8	8	146'	20'	300	others in same lot at 42,170 and 20 gpm
A. Wigle	2	9	8	252'	30'	85	sulphur
W. M. Lasonski	2	9	7	162'	16'	50	
P. Dick	2	9	6	172'	29'	82	
M. Wigle	2	9	8	148'	30'	200	
E. Fox	2	10	8	236'	35'	150	
J. Riska	3	8	6	223'	12'	40	
G. Bruner	3	8	8	188'	15'	50	
C. R. Dalton	3	8	8	113'	4'	33	
G. Dzoirka	3	9	6	153'	44'	50	
R. Bruner	3	9	6	146'	22'	40	
A. Casper	3	10	4	167'	40'	45	
J. Berg	4	12	6	64'	13'	50	
Derkach Bros.	4	19	8	111'	14'	50	
F. Dercach	4	19	7	110'	18'	67	
J. Milnik	4	20	6	145'	30'	100	
A. Fox	4	20	8	255'	20'	60	
do	4	20	8	135'	25'	400	
J. Sivy	4	21	6	176'	50'	33	
G. Whaley	4	22	10	375'	85'	33	
M. Clement	5	9	4	85'	12'	38	
T. Mastronardi	5	19	8	140'	6'	90	
R. Sharp	5	22	3	24'	4'	60	3 more-3"Dia.
K. Wigle	FCED	3	8	197'	18'	200	
A. Wigle	FCED	3	6	67'	12'	50	
K. Wigle	FCED	6	8	136'	25'	200	
D. Denhart	FCED	6	8	69'	30'	60	
H. Sellars	FCED	8	6	105'	50'	150	
A.N.Mastronardi	FCED	11	6	265'	40'	100	sulphur
R. Mallott	FCED	12	6	122'	38'	40	
A. Crncich	FCED	12	6	121'	40'	67	
F. Mastronardi	FCED	13	8	276'	Flow	65	
H. MacDonald	FCED	13	8	180'	40'	58	
W. Clifford	FCED	18	6	122'	25'	40	
B. F. Adams	FCWD	7	7	108'	14'	28	
E. Burndt	FCWD	9	3	52'	2'	60	
N. Chorba	FCWD	10	4	80'	12'	50	
F. Hopkins	FCWD	22	8	80'	7'	50	
H. Remark	FECD	4	10	410'	18'	50	

MAIDSTONE TOWNSHIP

W. H. Thomas	TRS	290	8	134'	66'	30	
do	TRS	291	8	128'	60'	30	sulphur

MALDEN TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (inches)	Depth	Static Level	Rated gpm	Water Formation
R. Kuhn	1	18	8	90'	6'	75	sulphur
Malden School area	5	52	6	73'	14'	80	
John Hlavac	7	59	7	137'	18'	30	

MERSEA TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (inches)	Depth	Static Level	Rated gpm	Water Formation
J. Shortak	1	2	8	390'	75'	150	
F. Pannunzio	1	2	8	160'	35'	100	
Sunniland Farms Ltd	1	2	8	172'	36'	50	sulphur
C. L. Dimenna	1	2	8	145'	112'	35	
J. Sergeant	1	3	8	410'	40'	60	
E. Atkin	1	3	8	30'	8'	75	
D. McCarthy	1	4	8	427'	55'	300	
W. Simpson	1	5	10	507'	145'	150	
S. Nickels	2	1	8	207'	95'	100	
F. Dimenna	2	3	8	77'	24'	30	
F. Cacciavillani	2	3	8	165'	45'	36	
V. Mastronardi	2	4	8	87'	17'	75	
J. Toews	2	5	8	60'	60'	333	
R. Ford	2	13	5	65'	7'	35	sulphur
M. Serenz	3	1	18	18'	3'	45	
E. Morse	3	4	4	103'	1'	50	
R. Moauro	3	4	8	135'	20'	125	
A. Mastrogelo	3	4	8	55'	20'	50	
J. Fernandes	3	5	8	74'	3'	75	
W. Willms	3	5	8	65'	2'	200	
J. Cervini	3	6	8	98'	Flow	30	
Unger Farms	4	1	8	164'	80'	35	
O. Sharp	4	1	4	180'	42'	42	
S. Nickels	4	3	8	155'	18'	60	sulphur
H. Borland	4	23	8	104'	14'	33	
F. Dick	5	4	3	136'	5'	36	
V. Hetherington	5	5	3	100'	6'	50	
W. James	5	6	3	120'		50	
A. Collison	4	7	3	100'	10'	33	
H. Rymal	4	8	3	97'	12'	50	
M. Newfield	5	13	4	105'	22'	40	
M. Koss	6	8	4	116'	2'	50	
S. Cyroki	7	3	4	100'	2'	33	
J. Dyck	7	4	4	127'		42	
J. Koop	7	5	8	156'	Flow	60	
J. Rauch	8	3	9	112'	8'	100	
H. A. Epps	TRN	228	8	112'	37'	50	
H. Beniuk	TRN	241	8	80'	Flow	50	
Oak Farms	TRN	242	8	100'	5'	50	
N. Maynard	TRN	242	8	110'	1'	300	
L. Grossi	TRN	244	8	145'	12'	35	
C. Prenton	TRS	237	8	542'	6'	600	sulphur & Minerals
H. Kurth	TRS	242	6	87'	12'	42	

ROCHESTER TOWNSHIP

OWNER	Con No.	Lot No.	Dia. (inches)	Depth	Static Level	Rated gpm	Water Formation
B. Knight	6	30	8	108'	12'	50	sulphur
Several other sulphur wells							
SANDWICH SOUTH TOWNSHIP							
A. Rivait	8	6	4	105'	36'	40	
Several sulphur wells							
SANDWICH WEST TOWNSHIP							
Essex Golf Club	1	24	8	101'	10'	96	sulphur
Several other sulphur wells							
TILBURY NORTH TOWNSHIP							
J. Duplesie	3	14	4	114'	14'	200	sulphur
D. McClounies	4	10	4	128'	15'	300	sulphur
Several other sulphur wells							
TILBURY WEST TOWNSHIP							
Several sulphur wells							
St.Clair Feeds	11	2	3	104'	12'	33	
H. Dietrich	11	2	3	102'	12'	33	
COMBER POLICE VILLAGE							
Village	MIRN	6	8	134'	12'	75	sulphur
do	MIRN	6	3	134'	12'	67	
Dept.Highways Ontario	MIRS	5	6	132'	28'	42	sulphur
Several sulphur wells							
WINDSOR CITY							
Windsor Packing Co.		21	4	132'	21'	25	sulphur
Famous Players		21		200'	30'	143	
Gelatin Products		21	10	360'	6'	125	sulphur & Mineral
Several other sulphur wells							
Famous Players		21	10	499'	7'	84	
General Foods		21	10	300'		450	sulphur & Mineral
P.U.C.			10	192'	32'	154	sulphur
AMHERSTBURG TOWN							
Calvert's Distillers				283'	33'	53	sulphur
SKD Mfg. Co.			6	100'	35'	35	
ESSEX TOWN							
Essex Town			10	200'			
do			8	200'		76	
do			10	201			
do			10	200			

HARROW TOWN

OWNER	Con No.	Lot No.	Dia. (inches)	Depth	Static Level	Rated gpm	Water Formation
Dept.Public Works			6	129'	12'	50	sulphur
Town			6	104'	Flow	42	
do				104'			
do				99'			
KINGSVILLE TOWN							
F. K. Jeisperson			8	106'	10'	30	sulphur
LEAMINGTON TOWN							
Pyramid Farms			8	115'	Flow	60	
Pyramid Canners			8	111'	6'	50	
Leamington Arena			8	152'	12'	50	
H. J. Heinz Co.			4	76'	14'	100	
Town			18	112'			
do				107'			
Arena			8	100'	10'	100	
do			4	125'	10'	30	
Pyramid Canners		243	10	123'	Flow	210	
TECUMSEH TOWN		None					

" Along with the "information explosion" in the scientific world during recent years, there has been rapid and enormous progress in the science and technology concerned with groundwater. The progress has stimulated a great deal of interest, and correspondingly a large amount of research, among a widely diversified group of scientists."

W. C. Walton in "Groundwater Resource Evaluation"

The Ministry of the Environment reports that for 1970 the records were on file for 3,330 wells. Seventy-three percent of these were said to yield fresh water, 21% sulphurous water, and 3% salty or mineral water. In some sections a high percentage of the wells were salty.

About 80% of the recorded wells are reported to terminate in the bedrock. Most of them get water from the upper few feet of this bedrock.

6. WATER LEGISLATION

Some form of legislative control is always necessary for the routine of an essential resource. This is particularly so with water. Essex County has a sound framework of this legislation. Most of this can be considered as provincial in origin. It applies to all the counties of the area in the same way.

The Ontario Water Resources Commission, created in 1956, played an important role in water works systems, in financing, building, and operating. This obligation is now carried out by the Ministry of the Environment.

Conservation Authorities are now in operation throughout South Western Ontario. This County is well served. No organized effort to conserve the water resources of this County has been put into effect, although some public measures intended for other purposes have no doubt had effects on conservation. Wastewater purification and the control of water pollution may be considered in this.

The construction of dams on small streams, and agricultural drainage measures are subject to provincial approval. Each has a relation to ground water.

Another measure, the control of water abstraction from the

surface and underground, while it may not be conservation in the strict sense, is a means for dividing the resource assets among those having some access.

7. CONSERVATION AUTHORITIES

A highly important step was taken by the Province when the Conservation Authorities Act was enacted. The objective of an Authority is to ensure the wise management of the renewable natural resources of its watershed. This includes water, soil, forests, and wildlife.

The development of the water resources of the area for the most beneficial uses has been one of the more significant activities under the administration of this legislation. Ground water is always an important part of this program. Dams constructed on major streams, primarily for flood control, must have a direct benefit upon ground water supplies. While it may be difficult to determine the precise extent of this, the effect must be substantial, and a considerable portion of the stream flow has penetrated through the soil and rock to reach the ground water reservoir.

8. POLLUTION POTENTIAL FOR WELLS

In considering the potential for pollution of the water in deep wells one must note the overburden of the rock and the natural removal of wastes by filtration. Deep wells are a barrier against bacterial pollution or anything which can be removed by natural filtration and absorption. This may not be effective against other wastes. Several factors may be at work in these formations, such as, the composition of the aquifer and its overburden, travel distance, chemical reactions, etc.

If pollutants are to be considered as anything which interferes with the normal quality of the water, then such natural occurring

substances as hardness, iron, sulphur and others, are pollutants. These may remain fairly uniform in quantity. The quantities of these in the water will be seen in the analyses of ground water given later in this report.

Another side of the question is whether unnatural or man-made substances may reach the ground water. This must always be guarded against. At this time, there is no indication of any serious amounts reaching these waters. Special care will be needed to ensure that these concentrates wastes are controlled. A tendency exists to pond these objectionable wastes and allow the liquids to evaporate or to seep away to the ground water. Where industries produce chemical wastes due consideration, and frequent checking, will be needed to ensure the ground water is not endangered.

9. WELL DATA

Much information has been secured on water use, and of ground water in particular. The potential use is most important. The data are tabulated in this report along with the interpretation of the figures.

The following summary of well data for the County lists those wells on file in the Provincial records.

Total Wells Drilled		3,753
Ending in:	Overburden	781
	Bedrock	2,961
Kinds of Water:		
	Fresh	2,655
	Salt	16
	Sulphur	846
	Mineral	78
	Dry hole	112
Water Use:		
	Domestic or stock	3,134
	Irrigation	220
	Industrial	39
	Commercial	64

Water Use - continued

Municipal	5
Public supply	92
Cooling	6
Not used	124
Test hole	44
Abandoned	212

PUBLIC WATER WORKS SYSTEMS

MUNICIPALITY or SYSTEM	DATE CONSTRUCTED	POPULATION SERVED	WATER SOURCE
Windsor	1872	179,234	Detroit River
Windsor-Tecumseh		30,483	Detroit River
Union Water System		25,000 + Heinz Co.	Lake Erie
Amherstburg	1891	8,300	Detroit River
Belle River		8,000	Detroit River
Essex	1890		Union system
Harrow		2,100	Lake System
Kingsville	1894	4,286	Union system 1975
Leamington	1891	10,208	Union system
St. Clair Beach		1,961	Windsor-Tecumseh system

Total population (1975) Government figures) for County: 310,342; including urban 237,369, Townships, 72,973. They are not the same as the populations served.

The water supplies for the public systems in Essex County are:

(a) WINDSOR, City

This is a surface supply, the water coming from the Detroit River. The treatment is modern for a surface supply, filtration, chlorination and fluoridation.

The total pumpage for 1975 was 10,989.42 mg; with an average daily flow of 27.20 mg; and a maximum daily flow of about 41.8 mg.

These works also supply water to Sandwich West Township, and part of Sandwich South Township - a total population of 179,234.

(b) WINDSOR-TECUMSEH WORKS

This system supplies water to part of Windsor, Town of Tecumseh, Village of St. Clair Beach, and parts of Sandwich South and Maidstone Township - a population of 30,483. This too is a modern plant with treatment similar to that of the Windsor works.

(c) UNION WATER SYSTEM

These supply works deliver water to a large area. Water is from Lake Erie, with modern treatment works.

Population supplied:

Pumpage: 1973: 1,721,974,000 gal.
1974: 1,856,660,000 gal.

This system is operated by the Ministry of the Environment for:

Town of Essex
Town of Kingsville
Town of Leamington
Township of Gosfield North
Township of Gosfield South
Township of Maidstone
Township of Mersea
Township of Rochester
Township of Sandwich South
H. J. Heinz Co. of Canada Ltd.

(d) AMHERSTBURG

The water source for Amherstburg is the Detroit River. Filtration, chlorination and fluoridation are in use. Water is also supplied to the neighbouring townships - a total population of 8,300.

(e) BELLE RIVER

The supply here is from Lake St. Clair, with filtration, chlorination and fluoridation. This serves a population of 8,000.

(f) ESSEX

The Town of Essex formerly operated its own water works, with water coming from wells. The treated supply is now derived from the Union Water System. Population 4,000.

(g) HARROW

The Town of Harrow has, for some years, operated its own plant, with water from Lake Erie. A new plant was to operate in 1975. Population 2,100.

(h) KINGSVILLE

Water is now from the Union Water System - Half the population served: 3,900.

(i) LEAMINGTON

Now secures water from the Union System.

(j) ST. CLAIR BEACH

Water from the Windsor-Tecumseh Plant.

INDUSTRIAL WELL SUPPLIES

While surface waters are widely used, this does not preclude the use of deep wells for certain industrial operations. Wells for this purpose may be entirely separate from the municipal systems or they may be connected for part of the needed supply.

Some industrial supplies now come from wells, but the tendency is to use surface supplies, chiefly from public systems. The quality of any domestic water supply, even if acceptable on public health grounds, may require further treatment or adjustment for a specific industry. That action must be taken by the industry.

WATER ANALYSES

Analytical data on the municipal water supplies are given herewith. While the public systems use surface sources these analyses will serve as a comparison for the ground water in the County. The raw waters are, in this instance, more significant since the treatment works are expected to produce a suitable water for domestic consumption.

WINDSOR WATER

Sample: March 26, 1974.

	Raw Water	Treated Supply	
Hardness	144	126	ppm
Alkalinity	88	79	
Iron (Fe)	2.1	0.10	
Chloride (Cl)	9	11	
pH	7.8	7.8	
Fluoride (Fl)	0.1	0.9	
Color		5	
Turbidity	39	1.2	

Similarly:

Averages of chemical analyses on samples from August 18, 1962 to June 30, 1972.

Hardness	106	106	ppm
Alkalinity	86.4	100	
Iron (Fe)	1.23	0.08	
Chloride (Cl)	11.9	13.5	
pH	8.0	7.7	
Color	5.2	2.8	
Turbidity	14.5	1.2	
Coliforms (per 100 ml)	1,794	0	
Fluoride (Fl)	0.15	0.8	
Calcium (Ca	30		
Magnesium (Mg)	8		
NH_3	0.06		

Note: in the treated supply fluoride has been added.

WINDSOR-TECUMSEH SYSTEM

Sample:

Hardness	125	125	ppm
Alkalinity	75	75	
Iron (Fe)	0.45	< 0.05	
Chloride (Cl)	12	12	
pH	8.0	7.4	
Fluoride	0.0	0.7 (added)	
Color units	12	< 5	
Turbidity units	11	0.45	

UNION WATER SYSTEM

Total Consumption 1974: 1,856,664,000 gal.

For 1975:	10,989.42 million gallons
Main Plant	27.200 MIGD Average
Tecumseh	2.908 MIGD Average

AMHERSTBURG

5 samples, March 21, 1973 to January 1, 1974

	Average	Maximum	Minimum
Hardness	112	118	106 ppm
Alkalinity	87	92	85
Iron (Fe)	1.6	5.9	0.15
Chloride (Cl)	24	31	16
pH	7.7	8.3	7.1
Fluoride (Fl)	0.1	0.2	0
Turbidity units	20.8	60	6.6

TREATED WATER 6 samples: March 21, 1973 to January 27, 1974.

Hardness	115	128	100 ppm
Alkalinity	75	82	71
Iron (Fe)	0.6	0.2	< 0.05
Chloride (Cl)	24	29	22
pH	7.3	7.7	7.1
Fluoride (Fl)	0.3	0.5	0.1
Turbidity units	0.61	1.4	0.24

Also on samples collected February 27, 1974.

	Raw Water	Treated Water
Hardness	120	124 ppm
Alkalinity	88	73
Iron (Fe)	2.8	< 0.05
Chloride (Cl)	13	21
pH	7.8	7.2
Fluoride (Fl)	0.1	0.8
Color	-	5
Turbidity units	44	0.20

BELLE RIVER

Sample: January 15, 1974

	Raw Water	Treated Water
Hardness	144	130 ppm
Alkalinity	92	88
Iron (Fe)	0.3	0.2
Chloride (Cl)	13	14
pH	7.9	7.8
Fluoride (Fl)	0.2	0.1
Color units	8.0	4.7
Turbidity units	8.0	4.7

ESSEX TOWN

Now from Union Water System. Amount 1974: 175,869,000 gal.

(former well system)

HARROW

Sample: March 27, 1974. Lake Supply

Hardness	140	142 ppm
Alkalinity	92	87
Iron (Fe)	3.4	2.8
Chloride (Cl)	37	39
pH	8.0	7.8
Fluoride (Fl)	0.1	0.1
Color units	+	+
Turbidity units	58	46

KINGSVILLE

Samples: from February 1, 1967 to July 1, 1972.

	Average	Range
Hardness	121	115-128 ppm
Alkalinity	89	85-95
Iron (Fe)	0.73	0.40-1.85
Chloride (Cl)	24	22-26
pH	7.9	7.6-8.1
Turbidity units	12.2	2.0-15.0
Fluoride (Fl)	0.2	0.2

Note: Kingsville is now securing the supply from the Union Water System.

LEAMINGTON

Supply from Union Water System. Amount: 1974: 511,140,000 gal. and the H. J. Heinz Co. Ltd. in Leamington. Amount: 1974: 687,210,000 gal.

ST. CLAIR BEACH

From Windsor-Tecumseh System (see analysis of that supply)

GROUND WATER ELEVATIONS

The static water elevations for the wells are listed in the well logs. These are the depths below the ground surface at the wells. If need be these can be converted to mean sea level. This will show the relationships among the well waters at the recognized or common base.

OBSERVATION WELLS

In Essex County, observation wells are utilized at:

No.	Location	Depth	Dia.
222	Colchester South, Con. 1, lot 54 in limestone	127'	6" - limestone
170	South Colchester Gore - lot 14	129'	6" - rock 5'
171	South Colchester Gore - lot 15	37'	6" - sand
164	Sandwich East Con. 3, lot 95	192'	10" - rock well

Graphs of water levels in the above wells show no lowering other than ups and downs with the seasons.

Charts have been prepared from the readings in these wells over a number of years. In this way, the levels of the ground water

can be noted. This information can be related to factors which may affect the level in the ground water reservoirs, such as rainfall, abnormal abstraction, etc.

Are these water levels receding? This is the situation in many places throughout the world unless the withdrawal is controlled. It must be a public concern where ground water is used. Many wells in parts of the world have suffered from salt water intrusion.

POLLUTION STATUS OF WELL WATERS

In Essex County at present there is no indication of unnatural pollution in these wells.

While it is gratifying that no evidence exists of surface pollutants gaining access to the aquifers, care will be needed to ensure against all risks. Seepage may come from wastes that are not readily filterable. It is recognized that minerals and other substances of various kinds may be picked up by the rain water as it travels downward.

It is contrary to The Public Health Act of the Province to use an abandoned well for disposal of wastes. This might contaminate the aquifer. Similarly care is needed in the use of very deep wells under pressure to avoid injury to water wells.

WASTE WATER DISPOSAL UNDERGROUND

Reference has been made to a procedure for disposal of waste waters in wells, either shallow or deep. The control of the former is difficult in that there is a tendency to use abandoned wells for this purpose. It should never be done, in that it tends to pollute the aquifer.

In Essex County, the use of deep well disposal has been used

to some extent. These measures are taken only after careful examination of the geology.

QUANTITIES OF WATER ABSTRACTED

In Essex County the municipal water supplies come from the surface. Well supplies are confined to private supplies and consequently a small overall volume.

The total precipitation annually over the County may be estimated at 460,109 x 686,000 gallons.

"In the earliest days of the human race, water was taken as found. It might be pure and abundant, plentiful but muddy, scarce but good, or both scarce and bad. To get more or better water, man moved to other sources rather than transport better water to his own location or try to improve the quality of water at hand."

M. N. Baker in "The Quest for Pure Water"

SUMMARY AND CONCLUSIONS

GROUND WATER IN SOUTHWESTERN ONTARIO

- A REPLENISHABLE SUPPLY -

The following summary and conclusions are based on information secured from many sources.

(1) The records of wells, water resources, water quality and purification, and adequacy of supplies for the County's needs have been examined.

(2) Municipal, public, industrial and private supplies have been studied.

(3) The County is fortunate in having large surface supplies within each reach, and in almost limitless amounts.

(4) All municipal systems receive supplies from surface waters. Some that were using well water have gradually gone to surface waters.

(5) The construction of large supply works, with effective purification, has done much to make possible the distribution of these waters to ever-widening areas.

(6) The amount of ground water withdrawn from the underground reservoirs is not known, but it is obvious that large amounts are taken daily. The replenishment of this is a favourable act of conservation.

(7) Some difficulties have been met in the smaller wells in the rural areas, in securing and maintaining a continuous supply of water.

(8) Much of the water is highly mineralized. Hardness is quite marked, sulphur is present in a substantial number of wells,

and total solids are high.

(9) Fluoridation of the public water supplies is practiced, and many of the wells no doubt contain a sufficient amount of natural fluoride for protection of teeth.

(10) There is no evidence as yet of surface pollutants reaching the aquifers. The control of these wastes, both in deep well disposal and on the surface is important.

(11) Protection of surface waters against man-made pollutants is essential, both for municipal water consumers and against contamination of the sub surface waters.

APPENDIX

4

COUNTY OF GREY

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

1 9 7 7

CONTENTS

COUNTY OF GREY

GREY COUNTY

One of the Northern Counties of South Western Ontario, Grey has a large area of 1,113,056 acres. It is a fine agricultural and commercial county, with the one city of Owen Sound, which is also the County centre for administrative purposes.

Grey county is picturesque, and the names of the municipalities have a familiar ring and a fine historical background. How much of the present advanced status of Grey can be attributed to its water resources is not clearly known, but it can be surmised that water has played an important role.

THE COUNTY

In the county, the municipal organization consists of one city - Owen Sound, 4 towns, 6 villages and 16 townships. The total population (1975 report) was 69,182 with 18,730 or 27% in the city of Owen Sound; 17,673 or 25.5% in towns and villages, and the 32,779 or 47.4% in the townships.

There is a total acreage of 1,113,056, and a population density of only 1 person for 16 acres. Thus, the rural population prevails, and water supply for those areas has added significance.

The total equalized assessment was $580,051,000. or an average of $6,384. A comparison may be made with other counties.

Grey County has a long and interesting background. While somewhat distant to areas for large consumption.

Proximity to the Great Lakes is a distinct advantage. Ground water for the inland needs is important.

DRAINAGE OF THE LAND

Drainage facilities for the agricultural land in the County are

satisfactory in general. There is the primary need of getting the water to a stream, and from there to a suitable outlet. Much work has been done in Southwestern Ontario towards rapid runoff of precipitation, thus making it feasible to work the land quickly after the rainfall.

The streams receiving the water from the land appear to be satisfactory, and as this flow reaches the larger streams good outlets are available.

Is this precipitation carried off too rapidly? If so, there will be a less amount finding its way into the ground water reservoir. Thus, it is a situation where an intermediate course may be essential for the common good.

There is much to be said in favor of drainage facilities of the County. There is a growing recognition of the benefits accruing from some control over undue haste in removing the rainfall from the land. This is especially true for ground water storage and conservation.

GEOLOGY OF THE AREA

The publication "Rocks and Minerals of Ontario states - "All of southern and southwestern Ontario, south of a line extending from Midland on Georgian Bay to Kingston on Lake Ontario, and west of the Frontenac Axis is underlain by Paleozoic rocks.

The limestone of the Detroit River Group lie above the Bois Blanc Formation. Above this Detroit River Group are the limestones and dolomites of the Dundee Formation."

The effects of these formations and the overburden has an important bearing on the ground water. The chemical content of these waters will be seen in the analyses of well waters.

INDUSTRIAL NEEDS

Since the County of Grey is not predominently industrial the need for water in the manufacturing industries is not so great. Industry, in general, appears in favor of getting water from a public system if at all feasible. Where the municipal source is ground water some industries prefer to have their own wells. An arrangement is often feasible where there is an agreement of mutual use. Not infrequently the one acts as a standby for the other.

Agriculture, as an industry, requires a great deal of water, distributed over the land and at intervals to nourish crops and livestock. Grey County has these needs. Seldom can these agricultural units be united into a single system.

RURAL WATER SUPPLIES

The fact that the County of Grey has so much agricultural land, places emphasis on the need for rural water supplies. This must be expected to come from wells. Here as in other counties there are fluctuations in water levels in the ground water. Prolonged dry periods may bring water shortages in shallow wells. This can usually be corrected by deepening the well. This also points to carrying the initial drilling to a good depth, with maximum yield.

Some of the more significant wells drilled in the County of Grey, as contained in the Ontario records, are shown in the following tabulation of this report.

WELL DRILLING RECORDS

The following data show the characteristics of some of the larger wells (higher flows) in this County. Most of them are for rural use. The chemical analyses of these waters may be related to others in the locality, either public or private systems.

ARTEMESIA TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
C. E. Taylor	12	32	7	90		30
Dept.Public Works	2	22	10	383	51	105
Ted Wilson	2	151	4	86	86	30
D.H.O.	1	133	4	60	8	30
A. Langer	1	163	6	118	6	35

BENTINCK TOWNSHIP

Hanover P.U.C.	Many test wells of varying flows					
Grey-Bruce Coop.	11	1	6	236	30	50
M. Sherk	12	28	4	63	15	30
Knetchel Milling Ltd.	1	24	5	216	60	30 sulphur

CHATSWORTH VILLAGE

NIL -

COLLINGWOOD TOWNSHIP

B. Jenkins	1	20	5	42	13	30
Crippled Childrens Camp	1	12	5	46	10	42
E. Robinson	9	30	6	108	25	30

DERBY TOWNSHIP

N. Graham	1	7	5	58	4	30
G. Schoenhals	4	13	5	110	4	110
T. Vokes	6	10	6	35	6	30
E. King	11	5	5	270	15	100
T. Fenton		20		60	27	45

DUNDALK VILLAGE

Village			10	273	23	45
do			10	201	21	118

DURHAM TOWN

P.U.C.			12	245	Flow	150
P.U.C.			12	269	Flow	60

EGREMONT TOWNSHIP

H. Watson	1	7	6	86	17	35

EUPHRASIA TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
G. Ferry	3	20	4	50	20	70

FLESHERTON VILLAGE

D.H.O.			7	89	6	30
E. Betts			4	138	Flow	100
Board Education			8	385	14	30
Village			5	156	24	40

GLENELG TOWNSHIP

N. Savage	3	14	4	83	Flow	50
T. Schulz	1	21	7	108	2	30
H. Pope	1	106	5	62	15	30
Hanover P.U.C.	Test Wells - 2 inches to 6 inches					

HOLLAND TOWNSHIP

K. Allen	10	13	4	116	8	30
F. Wheldon	1	3	5	120	3	30

KEPPEL TOWNSHIP

Township	20	8	6	100	22	15

NORMANBY TOWNSHIP

Central School	11	16	7	131	34	45
Farmers Meat Enterprise	14	4	7	126	6	207
J. Montag	14	3	5	83	40	40

OSPREY TOWNSHIP

S. Carr	4	15	4	33	2	30
Twp. School	7	12	6	76	27	30
Carmathon Lake Farm	A	10	6	60	29	30

PROTON TOWNSHIP

A. Phelan	5	25	4	125	35	30
A. Clark	8	38	5	86	15	30
G. Dyce	10	2	5	183	25	60
B. Edwards	17	27	4	89	4	30

SARAWAK TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
D. Goodfellow	1,	32	6	42	10	50
J. West	3	6	4	40	16	50

SULLIVAN TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
Dept.Lands & Forests	2	13	16	57	10	1000
do	2	13	19	92	4	1500
do	2	13	20	76	6	30
do	2	13	6	230	6	100
do	2	13	6	125	6	40
do	2	14	16	99	Flow	2190
do	2	16	14	63	--	Dry
do	3	15	7	184	Flow	30
O.W.R.C.	A number of test wells - 2" to 7"					
do	3	23	8	378	19	130
do	3	23	5	88	24	20

SYDENHAM TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
W. Chappell	12	11	5	111	45	30

THORNBURY TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
O.W.R.C.			2	90	6	27
do			6	90	6	66

THORNBURY VILLAGE

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
Village			4	156	Flow	20
O.W.R.C.			2	75	24	25

WELL DRILLING SUMMARY

Records of wells on file in Toronto.

Total wells drilled	4,132
Overburden	609
Bed Rock	3,517
Fresh Water	3,846
Salt	29
Sulphur	70
Mineral	48
Dry Hole	78
Domestic or live stock	3,656
Irrigation	8
Industrial	25
Commercial	128
Municipal	13
Public supply	145
Air conditioning	3
Not used	77
Test hole	41
Abandoned	119

WATER LEGISLATION

The question of effective legislation is always to the fore in the management or control of ground water. Is this adequate for the needs of the consumers? Most legislation pertaining to water is at the provincial level. In this procedure the Provincial Legislature passes laws which give a framework upon which the municipalities may operate or build upon. Certain restrictions are included.

Also contained in the provincial statutes are acts which provide for the creation of the Ontario Water Resources Commission, entirely a provincial agency, now administered by the Ministry of Environment; also the creation of conservation authorities, the construction of dams, and the control of water abstractions, both surface and underground.

Through all this legislation, effective administration of the water resources can be obtained. The Acts are brought up to date periodically as the need arises.

CONSERVATION AUTHORITIES

Special note is made of the creation and activities of the Conservation Authorities. The object of these bodies is the wise management of the renewable resources of the watershed. This includes water, soil, forests, and wildlife resources.

Ground water is an important resource in this overall program. When floods are retarded, the flow becomes more equalized, and the water has better opportunities for recharging the ground reservoirs. It becomes apparent that nature needs support by human measures to secure the best use of water as it falls on the earth and travels to its destination.

In the County of Grey, the area except the top of the peninsula is under conservation authorities. This can be an important factor in water management.

PUBLIC WATER WORKS SYSTEMS

The following municipal or public water works systems are in operation:

MUNICIPALITY	DATE CONSTRUCTED	POPULATION SUPPLIED	WATER SOURCE
Owen Sound	1880	18,730	Georgian Bay and Springs
Durham		2,511	2 wells
Hanover	1902	5,329	Lake 67% and Well 33%
Meaford	1895	4,260	2 wells
Thornbury		1,266	River
Dundalk		1,100	2 wells
Markdale		1,320	wells
	Total	34,516	

In this county - all use ground water.

It is estimated that in these municipal systems, with a population of 34,516 the annual consumption of water is 1,259 mg.

The annual precipitation over the county may be estimated at 1,113,056 x 686,000 gal. The ground water consumption in the municipal systems is estimated at 410 mg.

INFORMATION ON WATER SOURCES

The following information on deep wells and other water sources is made available from the local water works systems and the publications of the "Ministry of Environment - Ground Water in Ontario".

The water supplies for the public systems in Grey County are:

1. OWEN SOUND CITY

Georgian Bay, Filtered, Chlorinated, Fluoridated - Spring system fed from springs and gravity flow through Creamery Hill - pressure zones - total storage - 3.86 mg.

Analyses (Dec. 18, 1974)

Sources: #1 - water purification plant
#2 - spring water system

Sample	Hardness	Alkalinity	Fe	Chloride	pH	F	Color	Turb	S04
1	104	98	L0.05	5	8	0.1	L5	1.3	13.5
2	298	250	L0.05	10	7.4	0.9	L5	0.25	17.5

These results may be compared with the recommended standards.

2. DURHAM WATER WORKS

Source - two wells -

#1 well - gravity feed to 100 gal. ground reservoir and then pumped into system.

#2 well - pumped into system - 200,000 gal. standpipe - untreated - 500,000 gal. reservoir adjacent to standpipe.

#1 well - 8"diameter, 202' deep - November 1949 - 300 gpm to reservoir

#2 well - 12" diameter, 245' deep - January 1966 - 878 services - 2,472 population.

Analyses - March 25, 1975

Source	Hardness	Alkalinity	Fe	Chloride	pH	F	Color	Turb	S04
#2 Pump-House	334	223	L0.05	4	8	1.0	L5		
#1 Pump-House	300	240	L0.05	2.5	7.9	0.2	L5		

These figures are much alike except for the fluoride.

3. HANOVER WATER WORKS

Sources - (a) Ruhl Lake (b) Deep well

- Mixed in underground reservoir and them pumped to system
- Chlorination

Storage - 390,000 gal. in ground reservoir
208,000 gal. in elevated tank

Pumpage - total 258,947,000 gal.
about 67% from lake and 33% from well -
85,453,000 from well

Analyses

Source	Hardness	Alkalinity	Fe	Chloride	pH	F	Color	Turb	SO4
Ruhl Lake	268	191	L0.05	3	8.2	0.1	L5	0.8	26
Well	440	219	0.8	4	7.5	0.2	20	9.7	230

THORNBURY WATER WORKS

River supply - filtered and chlorinated

Analyses

Not Available

DUNDALK VILLAGE WATER WORKS

Source - 2 wells - chlorination - #1 2311 - about 70% of total pumpage (1973) - 29,074,500 gal. - with 20,345,200 gal. from #1 well, and 8,729,300 gal. from #2 well. Average daily 79,656 gal. 74 gal. per capita per day.

Analyses

Not Available

MEAFORD WATER WORKS

Ground water supply - 2 wells

Analyses

Source	Hardness	Alkalinity	Fe	Chloride	pH	F	Color	Turb	SO4
#1 well	248	234	L0.05	10	7.6	0.6	L5	0.25	
#2 well	228	226	L0.05	0.8	7.6	0.8	L5	0.35	

FLESHERTON VILLAGE

All by individual wells. No Municipal System.

Analyses - made January 1975 by Province

Source	Hard.	Alk.	Fe.	Cl.	PH	Color	Turb
G. Swanton	240	244	1.2	1.2	7.9	20	15
Mrs. M.A. Coleridge	292	263	0.05	2.5	7.7	-	0.25
R. Allison	300	266	L0.05	3.2	7.6	-	0.15
G. Clarke	252	237	-	0.6	8.2	10	7.9
Bernard's B.P. Stn.	292	260	0.05	2.6	7.6	-	0.40
A. White	280	222	1.3	7.0	8.2	10	12
W. Thompson	240	250	0.3	2.2	8.2	L5	3.8
H. W. Kernahan	244	230	0.9	1.7	8.1	L5	6.0
C. Richardson	240	241	0.2	1.1	7.8	L5	1.4
L. Shier	328	261	0.1	11.0	7.8	L5	1.0

MARKDALE VILLAGE

Operated by Municipality

Chlorination - Fluoride 0.864

NEUSTADT VILLAGE

Private supply

Analyses - November 21, 1974

Hardness	1760 ppm	Alkalinity	189
Fe	0.80	Cl	9.0
SO4 - 1500			

PRIVATELY OPERATED PUBLIC WATER WORKS SYSTEMS

The following water works systems are privately operated and may be considered as semi-public in that they do supply certain communities or hamlets.

BENTINCK TOWNSHIP

Durham Mobile Home W. W.

30" diameter well, 10' deep - 24 homes

Analyses - May 28, 1975

Hardness	360 ppm	Alkalinity	276
Fe	0.1	Cl	11.5
F	L0.1	Color	5
Turbidity 2.3			

COLLINGWOOD TOWNSHIP

Georgian Peaks Communal Water Works

Analysis - August 12, 1975

Hardness	90 ppm	Alkalinity	77
Fe	0.04	Cl	9.5
Color	L5		

Osler Bluff Water Works

Springs - 7 services

Analysis

Hardness	252 ppm	Alkalinity	252
Fe	0.46	Cl	105
pH	7.9	Color	10

Georgian Woodlands Subdivision

Source - Georgian Bay - chlorination

80 to 90 dwellings plus 22 in Tyrolean Village and 10 in Winter Park Road.

Analysis - January 5, 1975

Hardness	380 ppm	Alkalinity	291
Fe	L0.05	Cl	5.9
pH	7.4	Color	L5
Turbidity	2.1		

Georgian Shores Motel Water Works

Drilled well - 42 feet - pressure tank

Analysis - January 2, 1975

Hardness	1060 ppm	Alkalinity	300
Fe	0.05	Cl	170
pH	7.2	Turbidity	0.45
SO4	29		

Blue Mountain Winter Park

Spring-fed creek - chlorination

Analysis - January 8, 1975

Hardness	248 ppm	Alkalinity	227
Fe	0.2	Cl	2.3
pH	8.2	Color	5
Turbidity	5.2		

Blue Mountain Crippled Children's Camp

2 wells - filtration and softening

Analysis - July 9, 1974

Hardness	392 ppm	Alkalinity	291
Fe	3.0	Cl	62
pH	7.4	F	0.1
Color	140	Turbidity	16
SO_4	58		

EUPHRASIA TOWNSHIP

Kinberley Water Works

Well - from fissure in rock - chlorination - softened - 36 residences

Analysis - January 14, 1975

	Raw	Treated
Hardness	202	224 ppm
Alkilinity	170	191
Fe	0.1	0.1
Cl	2.5	4.0
pH	8.2	8.1
Color	20	L5

GLENELG TOWNSHIP

Stonehill's Sun and Snow Park

80 foot drilled well - pressure tank

Analysis - September 6, 1974

Hardness	110 ppm	Alkalinity	189
Fe	L0.05	Cl	0.9
pH	7.9		

HOLLAND TOWNSHIP

J. Jessop private Water Works System

Well - Analyses and description not available

BRANT TOWNSHIP

Marl Lake Water Works

#1 well - Spring-fed - dug
#2 well - Spring-fed - dug

About 35 cottages

Marl Lake Water Works - continued

Analyses	#1 Well	#2 Well
Hardness	412	280 ppm
Alkalinity	379	259
Fe	L0.05	L0.05
Cl	4.7	7.4
pH	7.2	7.4
F	0	0

SARAWAK TOWNSHIP

East Linton Water Association

A subdivision - north of Owen Sound

Supply from Georgian Bay - 28 services - no treatment

SYDENHAM TOWNSHIP

Bothwell Water Works Facilities

Source - Spring - Quarter mile east of Bothwell's Corner - 5 residences - chlorination

Analysis - May 5, 1975

Hardness	210 ppm	Alkalinity	193
Fe	0.05	Cl	2.5
pH	7.7	Color	L5
Turbidity	0.45		

Circle Subdivision Water Works

Well - 6 residences

Analysis - May 5, 1975

Hardness	236 ppm	Alkalinity	222
Fe	L0.05	Cl	2.0
pH	7.5	Color	L5
Turbidity	0.25		

Leith Water Works

J. Gregory - well

Analysis - May 26, 1975

Hardness	240 ppm	Alkalinity	219
Fe	0.10	Cl	7.0
pH	8.2	F	L0.1
Color	5	Turbidity	1.8

GROUND WATER ELEVATIONS

Static water levels are recorded for each well, along with other data. This shows the vertical distance between the ground surface at the well and the water level in the well when not in use. The common base for comparison of these water elevations is Mean Sea Level (MSL).

To convert the water level to the MSL base deduct the static level from the level of the ground surface (it is given in relation to MSL).

This result makes it convenient to compare water elevations and to observe the available heads for drainage above the sea level.

OBSERVATION WELLS

Records of the water elevations in the aquifers are noted and retained in a number of ways. Municipally operated wells generally include these elevations in their records. This furnishes a substantial amount of information throughout the areas of the province. The levels are also recorded in drilling operations, but these are only single figures.

Observation wells offer another facility for obtaining this information continuously or as often as desired. The Province records the data and makes it available publicly.

A periodic review of these levels should indicate any trend in ground water storage. The levels tend to fluctuate up and down with the rainfall. This must be expected. There does not appear to be any long-time lowering trend for these wells in the County. This means that the amount of water withdrawn is not in excess of the input.

POLLUTION STATUS OF GROUND WATER

At this time there is no indication of surface pollution finding its way into the deep aquifers. At the same time it is important

to so dispose of all wastes at the surface from the many operations that the ground water will be protected and its equality preserved. This is an effective way for conservation.

SUMMARY AND CONCLUSIONS

GROUND WATER COUNTY OF GREY

The following observations are based on information secured from several sources, with related interpretations. The ground water resource is highly important for Grey County.

(1) The records of wells, water resources, water quality and purification, along with adequacy of supplies for the County's needs have been examined.

(2) Attention has been given especially to municipal or public, industrial, and private water supply systems.

(3) Grey County is fortunate in having such water resources in the underground. This is certain to mean much to the welfare of the County in the future.

(4) The largest concentration of population viz Owen Sound City, does not use ground water.

There is no indication at this time for the need to transport water from a distant source. Forecasts for long term water needs are desirable on a continuing basis.

(5) The Municipal or public water works systems serve a total population of 36,400. The Municipalities of Durham, Hanover, Meaford, Dundalk, Markdale all use ground water, with an estimated annual consumption of 410 mg.

(6) The annual withdrawal of ground water for these public systems was small. To this should be added the withdrawal from wells for private use. To meet these requirements a large reservoir or aquifer is required, with continuous recharging.

(7) The annual precipitation over the area of Grey County is high in quantity. The withdrawal from the underground is small in comparison.

(8) The rural areas rely on wells, now developed by drilling. No great difficulty appears to have been encountered in getting sufficient water. The chemical content of much of the ground water is high but not dangerous. There is no undue problem as yet in controlling bacterial pollution. Chlorination is used as an added safeguard where considered expedient.

(9) In a number of wells, the water contains fluoride and is accordingly desirable for the protection of teeth. This mineral has been present in these waters for many years without knowledge of the consumers.

(10) There is no evidence as yet of man-made chemical pollution of deep wells, but care will be needed continuously to protect against this danger. The geological formations may be subject to crevices or lack of filtering facilities against such wastes. Under such conditions the chemical may be transported a long distance.

(11) The legislation for control of the water resources of the County is largely provincial in origin. It authorizes the local authorities to act and also sets minimum requirements in some directions.

(12) Conservation of ground water is essential throughout the County. This means the wise use of this renewable resource.

(13) The extensive use of ground water in the County is shown in the periodic tabulation of well drillings prepared by the Ministry of Environment.

APPENDIX

4

COUNTY OF GREY

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

1 9 7 7

CONTENTS

COUNTY OF GREY

GREY COUNTY

One of the Northern Counties of South Western Ontario, Grey has a large area of 1,113,056 acres. It is a fine agricultural and commercial county, with the one city of Owen Sound, which is also the County centre for administrative purposes.

Grey county is picturesque, and the names of the municipalities have a familiar ring and a fine historical background. How much of the present advanced status of Grey can be attributed to its water resources is not clearly known, but it can be surmised that water has played an important role.

THE COUNTY

In the county, the municipal organization consists of one city - Owen Sound, 4 towns, 6 villages and 16 townships. The total population (1975 report) was 69,182 with 18,730 or 27% in the city of Owen Sound; 17,673 or 25.5% in towns and villages, and the 32,779 or 47.4% in the townships.

There is a total acreage of 1,113,056, and a population density of only 1 person for 16 acres. Thus, the rural population prevails, and water supply for those areas has added significance.

The total equalized assessment was $580,051,000. or an average of $6,384. A comparison may be made with other counties.

Grey County has a long and interesting background. While somewhat distant to areas for large consumption.

Proximity to the Great Lakes is a distinct advantage. Ground water for the inland needs is important.

DRAINAGE OF THE LAND

Drainage facilities for the agricultural land in the County are

satisfactory in general. There is the primary need of getting the water to a stream, and from there to a suitable outlet. Much work has been done in Southwestern Ontario towards rapid runoff of precipitation, thus making it feasible to work the land quickly after the rainfall.

The streams receiving the water from the land appear to be satisfactory, and as this flow reaches the larger streams good outlets are available.

Is this precipitation carried off too rapidly? If so, there will be a less amount finding its way into the ground water reservoir. Thus, it is a situation where an intermediate course may be essential for the common good.

There is much to be said in favor of drainage facilities of the County. There is a growing recognition of the benefits accruing from some control over undue haste in removing the rainfall from the land. This is especially true for ground water storage and conservation.

GEOLOGY OF THE AREA

The publication "Rocks and Minerals of Ontario states - "All of southern and southwestern Ontario, south of a line extending from Midland on Georgian Bay to Kingston on Lake Ontario, and west of the Frontenac Axis is underlain by Paleozoic rocks.

The limestone of the Detroit River Group lie above the Bois Blanc Formation. Above this Detroit River Group are the limestones and dolomites of the Dundee Formation."

The effects of these formations and the overburden has an important bearing on the ground water. The chemical content of these waters will be seen in the analyses of well waters.

INDUSTRIAL NEEDS

Since the County of Grey is not predominently industrial the need for water in the manufacturing industries is not so great. Industry, in general, appears in favor of getting water from a public system if at all feasible. Where the municipal source is ground water some industries prefer to have their own wells. An arrangement is often feasible where there is an agreement of mutual use. Not infrequently the one acts as a standby for the other.

Agriculture, as an industry, requires a great deal of water, distributed over the land and at intervals to nourish crops and livestock. Grey County has these needs. Seldom can these agricultural units be united into a single system.

RURAL WATER SUPPLIES

The fact that the County of Grey has so much agricultural land, places emphasis on the need for rural water supplies. This must be expected to come from wells. Here as in other counties there are fluctuations in water levels in the ground water. Prolonged dry periods may bring water shortages in shallow wells, This can usually be corrected by deepening the well. This also points to carrying the initial drilling to a good depth, with maximum yield.

Some of the more significant wells drilled in the County of Grey, as contained in the Ontario records, are shown in the following tabulation of this report.

WELL DRILLING RECORDS

The following data show the characteristics of some of the larger wells (higher flows) in this County. Most of them are for rural use. The chemical analyses of these waters may be related to others in the locality, either public or private systems.

ARTEMESIA TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
C. E. Taylor	12	32	7	90		30
Dept.Public Works	2	22	10	383	51	105
Ted Wilson	2	151	4	86	86	30
D.H.O.	1	133	4	60	8	30
A. Langer	1	163	6	118	6	35

BENTINCK TOWNSHIP

Hanover P.U.C.	Many test wells of varying flows					
Grey-Bruce Coop.	11	1	6	236	30	50
M. Sherk	12	28	4	63	15	30
Knetchel Milling Ltd.	1	24	5	216	60	30 sulphur

CHATSWORTH VILLAGE

NIL -

COLLINGWOOD TOWNSHIP

B. Jenkins	1	20	5	42	13	30
Crippled Childrens Camp	1	12	5	46	10	42
E. Robinson	9	30	6	108	25	30

DERBY TOWNSHIP

N. Graham	1	7	5	58	4	30
G. Schoenhals	4	13	5	110	4	110
T. Vokes	6	10	6	35	6	30
E. King	11	5	5	270	15	100
T. Fenton		20		60	27	45

DUNDALK VILLAGE

Village			10	273	23	45
do			10	201	21	118

DURHAM TOWN

P.U.C.			12	245	Flow	150
P.U.C.			12	269	Flow	60

EGREMONT TOWNSHIP

H. Watson	1	7	6	86	17	35

EUPHRASIA TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
G. Ferry	3	20	4	50	20	70

FLESHERTON VILLAGE

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
D.H.O.			7	89	6	30
E. Betts			4	138	Flow	100
Board Education			8	385	14	30
Village			5	156	24	40

GLENELG TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
N. Savage	3	14	4	83	Flow	50
T. Schulz	1	21	7	108	2	30
H. Pope	1	106	5	62	15	30
Hanover P.U.C.	Test Wells - 2 inches to 6 inches					

HOLLAND TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
K. Allen	10	13	4	116	8	30
F. Wheldon	1	3	5	120	3	30

KEPPEL TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
Township	20	8	6	100	22	15

NORMANBY TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
Central School	11	16	7	131	34	45
Farmers Meat Enterprise	14	4	7	126	6	207
J. Montag	14	3	5	83	40	40

OSPREY TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
S. Carr	4	15	4	33	2	30
Twp. School	7	12	6	76	27	30
Carmathon Lake Farm	A	10	6	60	29	30

PROTON TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
A. Phelan	5	25	4	125	35	30
A. Clark	8	38	5	86	15	30
G. Dyce	10	2	5	183	25	60
B. Edwards	17	27	4	89	4	30

SARAWAK TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
D. Goodfellow	1,	32	6	42	10	50
J. West	3	6	4	40	16	50
SULLIVAN TOWNSHIP						
Dept.Lands & Forests	2	13	16	57	10	1000
do	2	13	19	92	4	1500
do	2	13	20	76	6	30
do	2	13	6	230	6	100
do	2	13	6	125	6	40
do	2	14	16	99	Flow	2190
do	2	16	14	63	--	Dry
do	3	15	7	184	Flow	30
O.W.R.C.	A number of test wells - 2" to 7"					
do	3	23	8	378	19	130
do	3	23	5	88	24	20
SYDENHAM TOWNSHIP						
W. Chappell	12	11	5	111	45	30
THORNBURY TOWNSHIP						
O.W.R.C.			2	90	6	27
do			6	90	6	66
THORNBURY VILLAGE						
Village			4	156	Flow	20
O.W.R.C.			2	75	24	25

WELL DRILLING SUMMARY

Records of wells on file in Toronto.

Total wells drilled	4,132
Overburden	609
Bed Rock	3,517
Fresh Water	3,846
Salt	29
Sulphur	70
Mineral	48
Dry Hole	78
Domestic or live stock	3,656
Irrigation	8
Industrial	25
Commercial	128
Municipal	13
Public supply	145
Air conditioning	3
Not used	77
Test hole	41
Abandoned	119

WATER LEGISLATION

The question of effective legislation is always to the fore in the management or control of ground water. Is this adequate for the needs of the consumers? Most legislation pertaining to water is at the provincial level. In this procedure the Provincial Legislature passes laws which give a framework upon which the municipalities may operate or build upon. Certain restrictions are included.

Also contained in the provincial statutes are acts which provide for the creation of the Ontario Water Resources Commission, entirely a provincial agency, now administered by the Ministry of Environment; also the creation of conservation authorities, the construction of dams, and the control of water abstractions, both surface and underground.

Through all this legislation, effective administration of the water resources can be obtained. The Acts are brought up to date periodically as the need arises.

CONSERVATION AUTHORITIES

Special note is made of the creation and activities of the Conservation Authorities. The object of these bodies is the wise management of the renewable resources of the watershed. This includes water, soil, forests, and wildlife resources.

Ground water is an important resource in this overall program. When floods are retarded, the flow becomes more equalized, and the water has better opportunities for recharging the ground reservoirs. It becomes apparent that nature needs support by human measures to secure the best use of water as it falls on the earth and travels to its destination.

In the County of Grey, the area except the top of the peninsula is under conservation authorities. This can be an important factor in water management.

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Source	Hard.	Alk.	Fe.	Cl.	PH	Color	Turb
G. Swanton	240	244	1.2	1.2	7.9	20	15
Mrs. M.A. Coleridge	292	263	0.05	2.5	7.7	-	0.25
R. Allison	300	266	L0.05	3.2	7.6	-	0.15
G. Clarke	252	237	-	0.6	8.2	10	7.9
Bernard's B.P. Stn.	292	260	0.05	2.6	7.6	-	0.40
A. White	280	222	1.3	7.0	8.2	10	12
W. Thompson	240	250	0.3	2.2	8.2	L5	3.8
H. W. Kernahan	244	230	0.9	1.7	8.1	L5	6.0
C. Richardson	240	241	0.2	1.1	7.8	L5	1.4
L. Shier	328	261	0.1	11.0	7.8	L5	1.0

MARKDALE VILLAGE

Operated by Municipality

Chlorination - Fluoride 0.864

NEUSTADT VILLAGE

Private supply

Analyses - November 21, 1974

Hardness 1760 ppm   Alkalinity 189
Fe 0.80   Cl 9.0
S04 - 1500

PRIVATELY OPERATED PUBLIC WATER WORKS SYSTEMS

The following water works systems are privately operated and may be considered as semi-public in that they do supply certain communities or hamlets.

BENTINCK TOWNSHIP

Durham Mobile Home W. W.

30" diameter well, 10' deep - 24 homes

Analyses - May 28, 1975

Hardness 360 ppm   Alkalinity 276
Fe 0.1   Cl 11.5
F L0.1   Color 5
Turbidity 2.3

COLLINGWOOD TOWNSHIP

Georgian Peaks Communal Water Works

Analysis - August 12, 1975

Hardness	90 ppm	Alkalinity	77
Fe	0.04	Cl	9.5
Color	L5		

Osler Bluff Water Works

Springs - 7 services

Analysis

Hardness	252 ppm	Alkalinity	252
Fe	0.46	Cl	105
pH	7.9	Color	10

Georgian Woodlands Subdivision

Source - Georgian Bay - chlorination

80 to 90 dwellings plus 22 in Tyrolean Village and 10 in Winter Park Road.

Analysis - January 5, 1975

Hardness	380 ppm	Alkalinity	291
Fe	L0.05	Cl	5.9
pH	7.4	Color	L5
Turbidity	2.1		

Georgian Shores Motel Water Works

Drilled well - 42 feet - pressure tank

Analysis - January 2, 1975

Hardness	1060 ppm	Alkalinity	300
Fe	0.05	Cl	170
pH	7.2	Turbidity	0.45
SO4	29		

Blue Mountain Winter Park

Spring-fed creek - chlorination

Analysis - January 8, 1975

Hardness	248 ppm	Alkalinity	227
Fe	0.2	Cl	2.3
pH	8.2	Color	5
Turbidity	5.2		

Blue Mountain Crippled Children's Camp

2 wells - filtration and softening

Analysis - July 9, 1974

Hardness	392 ppm	Alkalinity	291
Fe	3.0	Cl	62
pH	7.4	F	0.1
Color	140	Turbidity	16
SO4	58		

EUPHRASIA TOWNSHIP

Kinberley Water Works

Well - from fissure in rock - chlorination - softened - 36 residences

Analysis - January 14, 1975

	Raw	Treated
Hardness	202	224 ppm
Alkilinity	170	191
Fe	0.1	0.1
Cl	2.5	4.0
pH	8.2	8.1
Color	20	L5

GLENELG TOWNSHIP

Stonehill's Sun and Snow Park

80 foot drilled well - pressure tank

Analysis - September 6, 1974

Hardness	110 ppm	Alkalinity	189
Fe	L0.05	Cl	0.9
pH	7.9		

HOLLAND TOWNSHIP

J. Jessop private Water Works System

Well - Analyses and description not available

BRANT TOWNSHIP

Marl Lake Water Works

#1 well - Spring-fed - dug
#2 well - Spring-fed - dug

About 35 cottages

Marl Lake Water Works - continued

Analyses	#1 Well	#2 Well
Hardness	412	280 ppm
Alkalinity	379	259
Fe	L0.05	L0.05
Cl	4.7	7.4
pH	7.2	7.4
F	0	0

SARAWAK TOWNSHIP

East Linton Water Association

A subdivision - north of Owen Sound

Supply from Georgian Bay - 28 services - no treatment

SYDENHAM TOWNSHIP

Bothwell Water Works Facilities

Source - Spring - Quarter mile east of Bothwell's Corner - 5 residences - chlorination

Analysis - May 5, 1975

Hardness	210 ppm	Alkalinity	193
Fe	0.05	Cl	2.5
pH	7.7	Color	L5
Turbidity	0.45		

Circle Subdivision Water Works

Well - 6 residences

Analysis - May 5, 1975

Hardness	236 ppm	Alkalinity	222
Fe	L0.05	Cl	2.0
pH	7.5	Color	L5
Turbidity	0.25		

Leith Water Works

J. Gregory - well

Analysis - May 26, 1975

Hardness	240 ppm	Alkalinity	219
Fe	0.10	Cl	7.0
pH	8.2	F	L0.1
Color	5	Turbidity	1.8

GROUND WATER ELEVATIONS

Static water levels are recorded for each well, along with other data. This shows the vertical distance between the ground surface at the well and the water level in the well when not in use. The common base for comparison of these water elevations is Mean Sea Level (MSL).

To convert the water level to the MSL base deduct the static level from the level of the ground surface (it is given in relation to MSL).

This result makes it convenient to compare water elevations and to observe the available heads for drainage above the sea level.

OBSERVATION WELLS

Records of the water elevations in the aquifers are noted and retained in a number of ways. Municipally operated wells generally include these elevations in their records. This furnishes a substantial amount of information throughout the areas of the province. The levels are also recorded in drilling operations, but these are only single figures.

Observation wells offer another facility for obtaining this information continuously or as often as desired. The Province records the data and makes it available publicly.

A periodic review of these levels should indicate any trend in ground water storage. The levels tend to fluctuate up and down with the rainfall. This must be expected. There does not appear to be any long-time lowering trend for these wells in the County. This means that the amount of water withdrawn is not in excess of the input.

POLLUTION STATUS OF GROUND WATER

At this time there is no indication of surface pollution finding its way into the deep aquifers. At the same time it is important

to so dispose of all wastes at the surface from the many operations that the ground water will be protected and its equality preserved. This is an effective way for conservation.

SUMMARY AND CONCLUSIONS

GROUND WATER COUNTY OF GREY

The following observations are based on information secured from several sources, with related interpretations. The ground water resource is highly important for Grey County.

(1) The records of wells, water resources, water quality and purification, along with adequacy of supplies for the County's needs have been examined.

(2) Attention has been given especially to municipal or public, industrial, and private water supply systems.

(3) Grey County is fortunate in having such water resources in the underground. This is certain to mean much to the welfare of the County in the future.

(4) The largest concentration of population viz Owen Sound City, does not use ground water.

There is no indication at this time for the need to transport water from a distant source. Forecasts for long term water needs are desirable on a continuing basis.

(5) The Municipal or public water works systems serve a total population of 36,400. The Municipalities of Durham, Hanover, Meaford, Dundalk, Markdale all use ground water, with an estimated annual consumption of 410 mg.

(6) The annual withdrawal of ground water for these public systems was small. To this should be added the withdrawal from wells for private use. To meet these requirements a large reservoir or aquifer is required, with continuous recharging.

(7) The annual precipitation over the area of Grey County is high in quantity. The withdrawal from the underground is small in comparison.

(8) The rural areas rely on wells, now developed by drilling. No great difficulty appears to have been encountered in getting sufficient water. The chemical content of much of the ground water is high but not dangerous. There is no undue problem as yet in controlling bacterial pollution. Chlorination is used as an added safeguard where considered expedient.

(9) In a number of wells, the water contains fluoride and is accordingly desirable for the protection of teeth. This mineral has been present in these waters for many years without knowledge of the consumers.

(10) There is no evidence as yet of man-made chemical pollution of deep wells, but care will be needed continuously to protect against this danger. The geological formations may be subject to crevices or lack of filtering facilities against such wastes. Under such conditions the chemical may be transported a long distance.

(11) The legislation for control of the water resources of the County is largely provincial in origin. It authorizes the local authorities to act and also sets minimum requirements in some directions.

(12) Conservation of ground water is essential throughout the County. This means the wise use of this renewable resource.

(13) The extensive use of ground water in the County is shown in the periodic tabulation of well drillings prepared by the Ministry of Environment.

APPENDIX

5

COUNTY OF HURON

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

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CONTENTS

COUNTY OF HURON

COUNTY OF HURON

Huron County borders on a boundless supply of water. Lake Huron, as part of the Great Lakes System, serves many purposes, domestic use, industrial supply, transportation, recreation, and drainage outlet. The proximity of Lake Huron to all parts of the County ensures that water can be pumped inland wherever there is a sufficient demand.

THE COUNTY

The area of the County is 840,832 acres, as compared to Perth at 54,216 acres, and Lambton at 699,539 acres. The total population is 54,671. There is no city in the County. Goderich, the largest town, is the county centre. The towns and villages have 42% of the total population, with the remainder in the rural sector.

Access to the lake has no doubt influenced development in the county, both in the earlier days of water transportation and today.

DRAINAGE OF THE LAND

The main drainage outlet to Lake Huron is through the Maitland River, discharging at Goderich. Smaller streams carry off the rainfall or permit it to seep into the ground water. The Maitland Valley Conservation Authority covers this watershed. There is an opportunity through this to practice good conservation.

GEOLOGY OF THE COUNTY

The publication "Rocks and Minerals of Ontario" states:

"All of southern and southwestern Ontario, south of a line extending from Midland on Georgian Bay to Kingston on Lake Ontario, and west of the Frontenac Axis is underlain by Paleozoic rocks. These Paleozoic formations also extend up the Bruce Peninsula

and across into Manitoulin, Cockburn, and St. Joseph Islands.

The Limestones of the Detroit River Group lie above the Bois Blanc Formation. Above this Detroit River Group are the limestones and dolomites of the Dundee Formation."

The Dundee Formation encloses most of Huron County.

The effects of these formations and the overburden has an important effect on the ground water. The chemical content of these waters will be seen in the analyses of well waters.

INDUSTRIAL NEEDS

Industrial operations must be assured of an adequate water supply of good quality. While most of the large industries tend to concentrate in the large urban centres, there is still a need for industrial water in the smaller and rural parts.

Goderich, the largest centre in the County, derives water from lake Huron. No lack of water can be expected there. Emphasis, accordingly, needs to be focused on the needs of the rural areas - likely through ground water.

RURAL WATER SUPPLIES

Well water predominates in rural areas. Many of the old wells were dug, while later the practice has been to drill. The dug well, usually deep, ensures protection against surface pollution and affords also an economical supply for most uses. The first objective must be to get a sufficient quantity of water. The shallow well may be risky for prolonged dry periods.

There is also the increasing use of irrigation for agricultural practices. Will this be an important factor in the future of Huron County? Future planning will need to be mindful of the requirements for irrigation.

WELL-DRILLING RECORDS

The following data show some of the characteristics of a

portion of the larger or more significant drilled wells in the County. Most of them are for rural use. The table shows those wells expected to indicate conditions in general.

ASHFIELD TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM	
Dept.of Transport			10	193	67	125	In limestone
BRUSSELS VILLAGE							
P. U. C.			10	198	11	280	Limestone
CLINTON TOWN							
P. U. C.			16	360	255	700	Limestone
EXETER TOWN							
P. U. C.				34	24	100	Clay gravel
GODERICH TOWN							
Dominion Rock Salt Company			8	30	2	30	
Sifto Salt Co.			34	360	148	2000	
Dept. Transport			8	205	104	30	
H. Sutherland			8	280	112	75	
GODERICH TOWNSHIP							
Dept. Highways,Ont.		22	6	106	43	30	
GREY TOWNSHIP							
N. Terpstra	9	30	5	214	14	40	
HAY TOWNSHIP							
Tractor Equip.Co.	1	2	6	104	25	24	
Blue Water Rest Home	12	21	8	280	232	60	
do	12	21	8	308	240	60	
HENSALL VILLAGE							
P. U. C.	#2305		12	334	279	50	
P. U. C.	# 676		10	76	12	25	
P. U. C.	# 678		8	73	12	300	
HOWICK TOWNSHIP							
Twp. School	9	17	7	255	13	58	
Girl Guides	18	20	6	213	52	30	
M. Dennis	C	21	4	203	Flow	60	

OWNER	CON No.	LOT No.	DIA. (Inches)	DEPTH (ft.)	STATIC LEVEL	RATED GPM	
HULLETT TOWNSHIP							
School	10	25	7	59	45	40	
Old Mill	14	24	6	342	81	31	Sulphur
School Section	14	40	4	141	12	20	
McKILLOP TOWNSHIP							
Scott Poultry Farms	1	27	5	150	39	35	
F. Kling Co.	2	22	8	325	11	225	
J. Kerr	5	20	4	150	12	90	
F. Ryan	7	9	5	149	25	25	
O. Price	9	20	4	150	7	90	
NORRIS TOWNSHIP							
G. Hetherington	1	31	4	169	31	25	
STANLEY TOWNSHIP							
Proposed School	1	11	6	305	220	20	
McKinley Farms	11	8	5	315	262	25	
R. Grainger		14	5	160	2	27	
R. Nodden		19	5	130	21	24	
STEPHEN TOWNSHIP							
Dept. Transport			18	31	7	108	
Dashwood Indust.	1	2	5	345	281	20	
Many wells by Department of Transport data lacking							
Public School	10	11	6	244	226	20	
TUCKERSMITH TOWNSHIP							
Hensall P.U.C.	1	6	12	54	29	320	
do	2	11	6	228	125	30	
Tuckersmith Twp.	2	11	6	270	110	50	
do	1	30	8	290	231	35	
TURNBERRY TOWNSHIP							
A. Steckley	2	2	5		8	25	
USBORNE TOWNSHIP							
W. Essery	1	2	4	130	7	35	
P. U. C.	3	15	10	45	10	56	
P. U. C.	4	15	10	47	11		
P. U. C.	5	29	10	75	4	430	
R.C.A.F.	8	1	10	401	175	406	
WEST WAWANOSH TOWNSHIP							
R. McAllister	7	21	5		109	70	
Yundt Bros.	13	27	6		20	55	

LUCKNOW VILLAGE (West Wawanosh Twp.)

OWNER	CON No.	LOT No.	DIA. (Inches	DEPTH (ft.)	STATIC LEVEL	RATED GPM	
Village	14	13	8	38	2	207	
do	14	13	20	37	5	254	
WINGHAM TOWN							
P. U. C.	#1772			320		80	Sulphur
ZURICH VILLAGE							
Village	#1781		8	280	25	17	

Some of the wells in the preceding have been developed for urban use while others are for farm or individual use.

WATER LEGISLATION

Huron County is not different from other Counties in legislation on water resources. The Provincial enactments enable the local authorities to adopt procedures suitable for the management of water supplies. These statutes also contain the Ontario Water Resources Commission Act, the Conservation Authorities Act, the control over the construction of dams and reservoirs, and the abstraction of water from both surface and ground supplies. These procedures are kept modern by amendments periodically made to the legislation.

CONSERVATION AUTHORITIES

Particular attention should be directed to the programs of the various conservation authorities. These activities have been beneficial in many ways. They include water, soil, forests, and wildlife resources.

Ground water is an important branch in this program. By holding back the floods and equalizing flows, better use is made of the water. Greater quantities of the precipitation are forced into the underground, into that vast reservoir.

In the County of Huron, these conservation programs are directed by the Au Sable - Bayfield Conservation Authority, and the Maitland Valley Conservation Authority. Their programs are important in ground water conservation.

WATER USE DATA

Information has been collected on water use, and especially ground water. These data are tabulated herein, and interpretation of the information has been made and recorded. These are for public and semi-public systems.

PUBLIC WATER WORKS SYSTEMS

Municipality	Date Constructed	Population Supplied	Water Source
Clinton Town	1909	3,139	wells
Exeter Town	1911	3,390	wells
Goderich Town	1888	7,284	Lake Huron
Lake Huron Supply			Lake Huron
Seaforth Town	1876	2,061	wells
Wingham Town	1879	2,841	wells
Bayfield Village		497	wells
Blyth Village	1911	859	wells
Brussels Village		988	wells
Hensall Village		944	wells
Zurich Village		740	wells
Centralia, Stephen Twp.			wells
	Total	22,743	

It is common practice for some municipal systems to supply water beyond their municipal boundaries. The lake supply at Goderich is an example, delivering in all about 375 mg. annually.

The amount abstracted from the ground for these municipal systems may be estimated at 565 mg. annually. The total water consumption from the municipal systems is set at 830 mg. annually.

The total precipitation over the entire County may be estimated at 570.4 billion gallons annually.

The adequacy of precipitation to serve the many uses for water is evident.

INFORMATION ON WATER SOURCES

The following information on deep wells and other water sources is made available from the local water works systems and the publications of the "Ministry of the Environment - Ground Water in Ontario".

The following public water works systems are in operation in Huron County:

1. CLINTON WATER WORKS SYSTEM

2 drilled wells, #2 and #3 - #1 well closed
Chlorination - standpipe 100,000 gallons

#2 well - 12" diameter, 352' deep
#3 well - 12" diameter, 360' deep

Population served: 3,039 - 1,185 services

- old #1 well - 10" casing, depth 350'

Analyses - May 9, 1971

	#1 well (closed)	#2 well	#3 well	
Hardness	340	306	316	ppm
Alkalinity	286	256	256	
Fe	0.35	0.05	0.05	
Chloride	23	20	8	
pH	7.3	7.7	7.9	
Fluoride	1.0	0.6	1.1	
Total dis. solids	410	410	400	
SO_4	24	18	39	

2. EXETER WATER WORKS SYSTEM

3 wells plus spring, pumped to reservoir of 250,000 gallons chlorinated
60% of supply in 1973 from springs.
Capable of delivering 80 to 250 gpm.

Well Supplies

#1 - Moodie well - depth 37', diameter 6" to distribution system - well pump rated 300 gpm.
#2 - Hiebs well - depth 47', pump rated 200 gpm
#3 - Marlborough Street Well - depth 35', diameter 6", pump 55 gpm
#4 - Sample Main Pumphouse - treated water
#5 - Springs - treated

Total storage: 650,000 gallons, 1,260 services

Analyses - January 22, 1974

	#1 well	#2 well	#3 well	#4 well	#5 well
Hardness	292	288	344	420	320 ppm
Alkalinity	218	228	277	227	226
Fe	< 0.05	0.40	0.05	< 0.05	< 0.05
Chloride	6	6	27	20	20
pH	7.7	7.7	7.6	7.7	7.6
Fluoride	0.3	1.2	1.2	0.2	0.2
Color	< 5	5	< 5	< 5	< 5
Turbidity	0.2	5.2	0.50	0.15	0.15

3. GODERICH WATER WORKS

The supply is from Lake Huron through an intake, then to a filtration plant plus chlorination, thence to the distribution system. The system was constructed and is operated by the Ontario Water Resources Commission for the local Public Utilities Commission.

The water supply formerly came from the Lake through a shorter intake and was chlorinated only.

1974 flow - 373,675,000 gallons
Maximum flow 1,810,000 gallons, average 1,048,000 gallons

Analyses - February 4, 1974

	Raw	Treated
Hardness	200 ppm	188 ppm
Alkalinity	144	127
Fe	0.5	0.1
Chloride	18	19
pH	8.0	7.6
Color	30	< 5
Turbidity	17	2.8

4. SEAFORTH WATER WORKS SYSTEM

2 drilled wells - #1: 210 feet, rated 300 gpm
#2: 240 feet, rated 200 gpm
Standpipe 60,000 gallons underground reservoir 140,000 gallons
926 services, population 2,065.

Analyses - October 16, 1974

	Peerless #2 well	Layne #1 well
Hardness	336 ppm	420 ppm
Alkalinity	263	260
Fe	< 0.05	< 0.05
Chloride	28.5	45.5

4. Seaforth Water Works System - continued

	Peerless #2 well	Layne #1 well
pH	7.8	7.5
Fluoride	1.2	1.1
Color	< 5	< 5
Turbidity	1.5	0.40
SO_4	92	123

Peerless well used only periodically. Population 2,065 services 930
Layne well chlorinated - average daily 222,000 gallons elevated tank 60,000 gallons.

5. WINGHAM WATER WORKS SYSTEM

3 wells - 1 additional standby
#1 well: 275 feet deep, rated 500 gpm
#2 well: 325 feet deep, rated 375 gpm
#3 well: 335 feet deep, rated - new well

Analyses - November 23, 1973

	#1 well	#2 well	
Hardness	312	416	ppm
Alkalinity	231	230	
Fluoride	0.3	0.7	Main well flows
Chloride	4	8	continuously
pH	7.2	7.3	
Color	< 5	10	
Turbidity	1.7	7.5	Fl. not reported
SO_4	80	190	

Population 2,974, average daily flow (1970) 318,750 gallons, maximum 510,000 gallons. Average per capita per day - 106 gallons.

6. BLYTH WATER WORKS

2 wells in village - old well 8" diameter, 244' deep, static level 20', 100,000 gallon reservoir and 1 - 1,200 gallon pressure tank.
new well: 8" diameter, 260' deep, static level 25', - 1 - 1,200 gallon pressure tank - 340 services, 854 population.

Analyses - (Old Well)

Hardness	250	ppm
Alkalinity	208	
Fe	0.3	
Chloride	2.2	
pH	7.9	
Fluoride	1.4	
Color	10	
Turbidity	4.2	
SO_4	47.5	

7. BRUSSELS WATER WORKS SYSTEM

Flowing well - built 1972, average per day 115,628 gallons
Total 1972: 42,300,000 gallons.
#2 well, a standby

Analyses - May 31, 1972

	Old Well	New Well	
Hardness	420	416	ppm
Alkalinity	226	226	
Fe	0.1	1.1	
Chloride	7.6	7.9	
Fluoride	2.2	1.8	

8. HENSALL WATER WORKS SYSTEM

2 wells - old well to surface reservoir, then to system; new well direct to system. 385 services - population 960
P.U.C. storage 164,000 gallons.

Analyses - October 11, 1974

	Old Well #1	New Well #2	
Hardness	294	310	ppm
Alkalinity	252	248	
Fe	< 0.05	< 0.05	
Chloride	5.5	10.0	
pH	7.6	7.8	
Color	< 5	< 5	
Fluoride	1.0	0.6	
Turbidity	0.35	0.25	
SO_4	25	26	

#1 well: 39 feet deep
#2 well: 54 feet deep, static level 29.2, rated 320 gpm, 12"
built 1972.

9. ZURICH WATER WORKS

2 wells - #1: 8", 290 feet deep, capacity 120 gpm
#2: 8", 273 feet deep, 120 gpm capacity
pumpage (1973) - 21,962,000 gallons
(1974) - 15,554,000 gallons
329 services, average daily - 64,000 gallons
chlorinated - underground tank

Analyses - September 20, 1974

	#1 Well	#2 Well
Hardness	506	314 ppm
Alkalinity	146	158
Fe	0.15	0.10
Chloride	16	10
pH	7.7	7.8
Fluoride	2.2	2.2

9. Zurich Water Works - continued

	#1 Well	#2 Well
Color	$<$ 5	$<$ 5
Turbidity	2.5	1.2

The fluoride content is in excess of the recommended amount.

PRIVATELY OPERATED PUBLIC SYSTEMS

The following information is related to privately owned and operated water works in the County. These systems supply only a limited population and are usually an extension of a system created for a single dwelling or commercial plant.

1. ASHFIELD TOWNSHIP

Vogel Subdivision - Mr. and Mrs. E. Vogel -
- approved 1973
- no other data

Horizon View Water Works System

Well - data lacking

Analyses - August 15, 1974

Hardness	524 ppm
Alkalinity	155
Fe	0.4
Chloride	21.5
pH	7.9
Fluoride	2.0
Color	$<$ 5
Turbidity	3.6
SO_4	720

August 1, 1975, water works systems in operation as recorded in Township:

(a) Kentail Beach Water Works
(b) Amberley Beach Water Works
(c) Huron Sands Water Works
(d) Horizon View Water Works
(e) Huron Shores Water Works
(f) Knights Subdivision Water Works
(g) Mid-Huron Water Works
(h) Kelly's Beach Water Works

Kelly's Beach Water Works

Analyses

	Well
Hardness	298 ppm
Alkalinity	179
Fe	0.2
Chloride	4
pH	7.6
Color	< 5
Turbidity	1.5
SO_4	180

2. COLBORNE TOWNSHIP

Bogie's Beach Lower Water Works

Analyses- July 3, 1973

	Well
Hardness	532 ppm
Alkalinity	176
Fe Iron	1.8
Chloride	32
pH	7.6
Color	< 5
Turbidity	16

Mero Private Water Works - Mr. and Mrs. D. Mero

Well - 120 gallon pressure tank, no treatment, 12 houses

Analyses

	Well
Hardness	214 ppm
Alkalinity	186
Fe	0.2
pH	7.6
Chloride	2
Fluoride	1.4
Color	< 5
Turbidity	1.3

3. GODERICH TOWNSHIP

Summer Haven Water Works

Analyses

	Well
Hardness	408 ppm
Alkalinity	219
Fe	0.85
Chloride	54
pH	7.7
Color	< 5
Turbidity	7.3

3. Goderich Township - continued

Blue Water Beach Water Works

Information not available.

4. GREY TOWNSHIP

Molesworth Municipal Water Works

Well - 128 feet deep, two - 125 gallon pressure tanks, 38 services.

Analyses - October 23, 1974

	Well
Hardness	488 ppm
Alkalinity	255
Fe	0.20
Chloride	16
pH	7.2
Fluoride	0.9
Color	< 5
SO_4	234

5. HAY TOWNSHIP

Kleinstiver Highland Water Works

One of a number of small systems in this area.

6. HOWICK TOWNSHIP

McInnis Well Water System
Police Village of Fordwich

Well - 4" diameter.

Analyses - April 1, 1975

	Well
Hardness	312 ppm
Fe	0.3
Color	5 - 15
Turbidity	5
SO_4	50

Huron County Garage Water Works

Well - 110 feet deep, 600 gallons per hour - 20 services

6. Howick Township - continued

Huron County Garage Water Works - continued

Analyses - August 8, 1973

	Well
Hardness	316 ppm
Alkalinity	268
Fe	0.85
Chloride	4.0
pH	7.3
Color	7.3

Auburn Hamlet

Robinson Water Works

Well - 150 feet deep, - 17 services

Analyses - April 22, 1975

	Well
Hardness	264 ppm
Alkalinity	246
Fe	0.5
Chloride	8.5
Fluoride	1.2
pH	7.7
Color	5
Turbidity	3.8

Lawson Water Works

Analyses - April 22, 1975

	Well
Hardness	322 ppm
Alkalinity	289
Fe	0.8
Chloride	24.5
pH	7.5
Fluoride	1.0
Color	20
Turbidity	8.4

Varna Village Water Works

Well - 230 feet deept, 325 gallon pressure tank
no treatment - 33 services, 5" diameter.

Analyses - October 9, 1974

	Well
Hardness	228 ppm
Alkalinity	232
Fe	0.5
Chloride	1.0
pH	8.0
Fluoride	1.4
SO_4	20

7. TOWNSHIP OF STANLEY

Huston Heights Water Works

2 wells - softened

Analyses - June 27, 1972

	#1 Well
Hardness	780 ppm
Alkalinity	187
Fe	2.8
Chloride	48
pH	7.3
Fluoride	1.7
SO_4	1186

Analyses - June 29, 1972

	#2 Well	
	Untreated	Softened
Hardness	1480	18 ppm
Alkalinity	190	203
Fe	2.5	0.2
Chloride	42	46
pH	7.7	7.3
Fluoride	1.8	2.0
SO_4	1200	1200

Dashwood Community

Five subdivisions in area - approval granted March 11, 1975 for water works system.

8. STEPHEN TOWNSHIP

Kingsmere Syndicate Water Works

Analyses - July 3, 1973

	Well
Hardness	314 ppm
Alkalinity	261
Fe	0.05
Chloride	6
pH	7.3

Huron Industrial Park

2 wells, chlorinated - average daily consumption 1973: 296,000 gallons per day, maximum 523,700 gallons per day.

Analyses -

#1 - raw water at Well #2; #2 - treated water at Well #2
#3 - raw water at Well #1

	#1 Well	#2 Well	#3 Well	
Hardness	312	296	300	ppm
Alkalinity	236	214	216	
Fe	0.05	< 0.05	0.10	
Chloride	9	7	7	
pH	7.8	7.7	7.7	
Fluoride	0.6	1.0	1.1	
Turbidity	0.3	0.25	0.2	

Dashwood Village (Twp. of Stephen & Hay)

Information not available

9. WAWANOSH WEST TOWNSHIP

Brucefield Water Works System

Village system proposed - well

Analyses -	WELL
Hardness	282 ppm
Alkalinity	238
Fe	0.05
Chloride	15
Fluoride	1.0
Turbidity	1.

Egmondville Water Works System

2 drilled wells, 2 distribution systems (interconnected)
Well #1: 270 feet deep, 10,250 gallons underground reservoir and 300 gallon tank
Well #2: 228 feet deep, 600 gallon tank
111 services, about half on each system

Analyses - September 24, 1974

	#1 Well	#2 Well	
Hardness	292	302	ppm
Alkalinity	222	229	
Fe	< 0.05	< 0.05	
Chloride	18	9	
pH	7.4	7.4	
Color	0.95	0.15	

Dawson Pointe Water Works - Duvgamon

Well: 252 feet deep, 38 services, pressure tank

Analyses - February 5, 1974

	Well
Hardness	228 ppm
Alkalinity	208
Fe	1.4 (later sample was 0.15)
Chloride	4
pH	7.7
Fluoride	1.0
Color	5
Turbidity	4.3

Lawson Water Works

Well: 165 feet deep, 4" diameter, 200 gallon pressure tank, no treatment - 27 services

Analyses - February 5, 1974 - in 3 residences

	Well
Hardness	318 - 320 ppm
Alkalinity	279 - 284
Fe	$<$ 0.05- 0.10
Chloride	25 - 26
pH	7.6 - 7.7
Fluoride	1.0 - 1.1
Color	5
Turbidity	0.35 - 0.85

The foregoing list of privately owned water works systems supplying the public reveals a larger number of these than in most counties. It can be attributed to high per capita costs for small communities and to the desire to have piped water supplies available.

The quality of these waters for domestic consumption is open to question. Bacteriological standards are not difficult to secure in deep wells in a depth of overburden. The chemical qualities are quite different. Penetration of the water through the ground increases the contents of minerals.

High hardness is common. Against a reasonable figure of 100 ppm, these waters often reach the 500 range, one as high as 1480. Such waters are inconvenient for home use.

Iron is also high. Figures of between 1 and 2 ppm are found as against a reasonable figure of 0.25.

A favourable feature is to be found in the fluoride content. A standard of 1 ppm is generally accepted as beneficial. The waters in a number of instances exceed these figures, some as high as 2 ppm. This should aid materially in the protection of teeth. The high figure may cause staining.

GROUND WATER ELEVATIONS

Static water levels for the drilled wells are recorded in the well data published by the Province, so also is the ground water elevation at the well site. The latter is in relation to the mean sea level (MSL).

From the above information it is simple to convert all water levels in the wells to the common base. The result of this shows the head available between the water in the well and the sea level. The ultimate outlet is the ocean. The fall from the origin of the well to the outlet is thus made available. How much of the precipitation reaches the sea is not recorded or known.

OBSERVATION WELLS

An observation well is, as the name implies, for observing the fluctuations in water levels in a well. Continuous records are available in a number of these wells maintained by the Province. The records at the time wells are drilled are also on file and in the publications. Other sources of water levels are available for some centres.

Modern observation wells are equipped with mechanism for continuous recording of the levels. This shows clearly the trends in levels over a prolonged period and the effects of local conditions, such as rainfall and withdrawals.

In Huron County, 11 observation wells have been made available. These are:

Well No. 346, in Morris Township, Concession 8, lot 27
Well No. 347, in Morris Township, Concession 8, lot 27
Well No. 348, in Morris Township, Concession 8, lot 27
Well No. 349, in Morris Township, Concession 8, lot 26
Well No. 350, in Morris Township, Concession 8, lot 26
Well No. 351, in Morris Township, Concession 8, lot 26
Well No. 352, in Morris Township, Concession 8, lot 26
Well No. 353, in Morris Township, Concession 8, lot 27
Well No. 354, in Morris Township, Concession 8, lot 27
Well No. 355, in Morris Township, Concession 8, lot 27
Well No. 376, in Morris Township, Concession 8, lot 27

POLLUTION STATUS OF GROUND WATER

No indication has been revealed of surface pollution gaining access into the deep aquifers. The overburden and rocks act as a filter. This condition may not always continue. It is important to dispose of all wastes at the surface so that the ground water will be protected in quality. Periodic checking should be carried out as a valuable conservation measure.

GROUND WATER - COUNTY OF HURON

The following observations are made on information secured from a number of sources, with related interpretations.

(1) The records of wells, water resources, water quality and purification, and adequacy of supplies for the County's needs have been examined.

(2) Special attention has been given to municipal or public, industrial, and private water supplies, as the largest consumers from specific sites.

(3) There is no city or large industrial centre in the County and consequently no great consumer of waters.

(4) The municipal or public water works systems serve a population of 22,743, with an annual estimated consumption of 565 mg. The municipalities of Centralia, Clinton, Exeter, Seaforth, Wingham, Bayfield, Blyth, Brussels, Hensall and Zurich use ground water for their public supplies. This is 68% of the total population of these centres.

(5) The annual withdrawal of gound water from these public systems is 565 million gallons. To this must be added the withdrawal from wells for private use. A large undergound reservoir is necessary to balance the supply and demand.

(6) Rural areas must rely chiefly on wells. These are drilled as required. No great difficulty seems to have been experienced in getting enough. The chemical content of water from deep wells is often high. These figures must be compared with the standards or objectives set for domestic use.

(7) A desirable feature of well water is often the presence of fluoride in concentrations considered to be beneficial in the protection of teeth, approximately 1 ppm.

(8) There is no evidence as yet of man-made chemical or bacterial pollution of deep wells. The overburden acts as an efficient filter. Care will be needed to protect against this ever-present danger. Periodic examinations should be a requirement for these waters.

(9) The legislation for the control of water resources, largely provincial measures must be considered to be satisfactory.

(10) Conservation of ground water is essential in those areas where deep wells are used.

(11) The use of ground water in the County is shown by the tabulation of well drillings prepared by the Ministry of the Environment. This is being added to regularly and these records will continue to serve a most useful purpose.

APPENDIX

6

COUNTY OF KENT

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

1 9 7 7

CONTENTS

COUNTY OF KENT

COUNTY OF KENT

Kent County is in the heart of a great agricultural area of the Province. It is favored in many respects, abundant water supply is at hand on two sides, Lake St. Clair and Lake Erie. The one city of the County, Chatham, is quite central. This land may be considered to be most favorable in so many ways.

THE COUNTY

Kent, in addition to one city, has six towns, four villages and ten townships. The total population of 103,229 finds activities in industry, commerce, and residential living.

The total population consists of 37,803 in the one city, 28,717 or 27.8% in towns and villages, and 36,709 or 36% in the townships. Thus no extremes of population are found in any one sector. There is a total acreage of 586,613 and an average population density of 6 per acre. The total equalized assessment was 864,644,000.

Kent County is an old settlement. Much interesting information on those early days is found in the book - "Romantic Kent" - the story of the County from 1626 to 1952, by Victor Lauriston. The author describes the occupation of this land by the Indians. He states that settlement definitely antedated 1790 yet there are no definite dates. Water transportation had a conspicuous influence on the areas to be settled.

It is clear that the land known as Kent County has been in use for many years. Water resources must have been during all that time an important factor. Since in the early dates there was little means for transporting water, reliance must have been on ground water for all except those close to a stream.

This is in great contrast to the modern programs for bringing water long distances inland from the lakes.

The Thames River divides the lands of the County. This has played a prominent role for many years. Numerous studies and investigations have been made on it, the most recent one being entitled - "Water Management Study - Thames River Basin", by the Ministry of the Environment and the Ministry of Natural Resources.

DRAINAGE OF THE LAND

Kent County is not easily drained. It is low land, and much effort has been made to provide drainage facilities. It has been a good place to practice land drainage engineering. This does not prevent precipitation seeping into the ground for the maintenance of the ground water reservoirs.

GEOLOGY OF THE AREA

There has been much study on the geology of the County, and from these, valuable information has been made available in reports, maps, and other material.

It is stated that in most parts of the County the bedrock is composed of grey black shale and shaly limestones of the Hamilton Group and Kettle Point Formation of the Devonian Age. Most of the overburden is composed of glacial drift, mainly clays, clay tills and some surface sand deposits. The thickness of this varies between about 30 feet in the Gore of the Township of Camden to over 400 feet in the southeast part of the Township of Orford.

These deposits influence the chemical analyses of the well water as will be seen in the analyses reported herein.

The majority of water wells in the County, it is stated, obtain water from saturated sands and gravels of varying thicknesses immediately overlying the bedrock or from the upper few feet of the

bedrock. These overburdens determine the rate of yield. Near the surface, sand deposits create favorable conditions for dug, bored, and driven wells.

INDUSTRIAL NEEDS

Industrial operations in Kent are substantial. They demand water easily available in quantity and suitable in quality - Canning of agricultural products - Other industries have been added from time to time. These needed water in varying amounts depending on the nature of the process.

Chatham, until recently, secured water from the Thames River. While the quality of the raw water was not favorable, it was treated by filtration and chlorination. It had the advantage of being convenient and adequate. This supply was replaced with one pumped from Lake Erie, thus bringing a much superior quality and at the same time being adequate in volume. Industry and population cooperate in this measure.

RURAL WATER SUPPLIES

The population in the rural areas rely primarily on wells, dug, driven, or drilled. If water can be secured at shallow depths it is much more economical and likely to be better in chemical quality than the deeper wells. The great risk or difficulty rests in the experience of shortage during prolonged periods of low rainfall. These periods are irregular and likely to be in cycles.

Some of the more significant wells drilled in the County are shown in the tabulation in this report.

WELL DRILLING RECORDS

The following data show the characteristics of some of the larger wells in this County. Most of them are for rural use. The chemical analyses of these waters may be related to others in the locality, either public or private systems.

CAMDEN TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (Ft)	STATIC LEVEL	RATED GPM
K. Hawkins	5	1	5	65	8	27
Dresden Town	3	1	8	57	10	75
M. McKay	4	1	6	65	9	36
CHATHAM TOWNSHIP						
N. Spurgeon	5	1	30	50	17	30
do	5	1	4	73	5	40
Many dry wells						
North American Plastics	18	2	10	92	18	50
DOVER TOWNSHIP						
Township	12	12	4	64	9	20
HARWICH TOWNSHIP						
R. Eastman	2	10	8	215	75	150
S. Spokosz	3	D	4	10	137	25
D. McGuigan	4	11	8	187	85	100
M. Rigby	3	15	10	151	50	120
Dept. Lands and Forests	#2804		3	36	5	43
do	#2807		3	28	8	40
do	#5182		5	36	6	60
E. Clunis	3	1	4	57	17	300
HOWARD TOWNSHIP						
Thamesville P.U.C.	1	15	6	73	25	155
Ridetown Golf Club	11	7	8	200	110	66
ORFORD TOWNSHIP						
School Board	6	9	7	193	98	50
RALEIGH TOWNSHIP						
F. Price	4	18	4	30	72	25
R. Bradley	5	18	4	72	35	125
Merlin Fair Board	11	4	6	153	40	300
Frederick Transport	5	19	8	71	18	40
ROMNEY TOWNSHIP						
J. Patrick	3	45	4	154	18	25
BLENHEIM TOWN						
P. U. C.	#2		12	217		

DRESDEN TOWN

OWNER	CON No.	LOT No.	DIA. (inches)	DFPTH (ft)	STATIC LEVEL	RATED GPM
Town	#2548		5	50	26	33
ERIE BEACH VILLAGE						
Erie Water Supply	#2573		6	114	14	25

NOTE:
In addition to the above wells, the records show many were drilled, only to prove dry or of low rated capacity.

WATER LEGISLATION

Like in most other counties, most legislation related to water resources is provincial in origin. Water works systems, while operated locally, receive authority from the provincial acts. Also contained in the provincial statutes are the creation of the Ontario Water Resources Commission Act, the Conservation Authorities Act, the construction of dams, and the control of water abstractions, both surface and underground. These have been most beneficial and continue to serve. They are modernized from time to time by amendments to the legislation.

Under The Ontario Water Resources Commission Act a number of water systems have been designed, constructed, financed and operated.

CONSERVATION AUTHORITIES

Special note needs to be made to the activities of the Conservation Authorities. The objective of these authorities is the wise management of the renewable natural resources of the watershed. This includes water, soil, forests, and wildlife resources.

Ground water must become an important resource in this program. By holding back the floods and equalizing flows, better use is made of the water. There are many ways of improving natural water conditions.

In the County of Kent the Lower Thames Conservation Authority is the agency of administration. It includes much of the watershed of the Thames River. This stream is an effective drainage outlet for these adjacent lands.

WELL DATA

Information has been collected on water use, and particularly ground water. These data are tabulated herewith and interpretation of the data has been made and recorded later herein.

Records compiled by the Ontario Water Resources Commission (now a branch of the Ministry of Environment) are listed herewith in summary form.

Total wells drilled	5,854	Water Use	
Ending in overburden	2,094	Domestic or live stock	3,331
Ending in bedrock	3,765	Irrigation	20
		Industrial	24
Kinds of water:		Commercial	96
Fresh	3,764	Municipal	14
Salt	112	Public supply	96
Sulphur	43	Cooling	7
Mineral	20	Not used	403
Dry hole	1,801	Test hole	47
		Abandoned	2,248

PUBLIC WATER WORKS SYSTEMS

The following municipal water works systems are in operation or proposed:

Municipality	Date Constructed	Population Supplied	Water Source
Chatham City	1891	37,803	Lake Erie
Blenheim Town		3,619	Lake Erie
Bothwell Town			proposed
Dresden Town		2,416	Sydenham River
Ridgetown Town		3,076	wells
Tilbury Town		4,215	Lake St. Clair
Wallaceburg Town		10,717	River
Dover Township:			
(a) Paincourt System			wells
(b) Mitchell's Bay			Lake St. Clair
Tilbury N.,Stoney Point			Lake St. Clair
Tilbury West			Lake - area
Comber P.Village			Lake
Wheatley Village		1,591	Lake

Ground waters are used only in Ridgetown and Paincourt in Dover Township for a population of approximately 3,500.

INFORMATION ON WATER SUPPLIES

The following information on deep wells and other water sources is made available from the local water works systems and the publications of the "Ministry of the Environment - Ground Water in Ontario".

The water supplies for the public water works systems in Kent County are:

1. CHATHAM CITY - area - 5,498 acres

   The water supply now comes from Lake Erie, since October 1973. Formerly came from the Thames River. Present system is purified by filtration, and chlorination.

2. BLENHEIM TOWN

   Supply from Lake Erie - filtration, chlorination and fluoridation. (see analyses)

3. BOTHWELL TOWN

   System under consideration - private system supplies part.

4. DRESDEN TOWN

   Source Sydenham River, with treatment by softening, filtration, and chlorination (see analyses)

5. RIDGETOWN TOWN

   Source wells - Population 2,804 - no treatment.

6. TILBURY TOWN

   Source - Lake St. Clair - Treatment - filtration, chlorination and fluoridation (see analyses)

7. WALLACEBURG

   Source - Sydenham River water - Treatment - filtration and chlorination - capacity 2,300,000 gallons per day.

   Average consumption 2,254,000 gallons per day (see analyses)

8. ERIEAU VILLAGE

Population 447 - water works system to be constructed

Supply - Lake Erie

9. HIGHGATE VILLAGE

No municipal system. Population 382.

Privately operated systems supply part

10. THAMESVILLE VILLAGE

System proposed. Population 972.

11. WHEATLEY VILLAGE

Lake Erie Supply - filtration, chlorination. Population 1,680.

PRIVATELY OPERATED PUBLIC SYSTEMS

A number of privately owned and operated water works systems are in operation in the County. Some details on these are included.

1. TOWN OF BOTHWELL

Walter's private water works system
drilled well - 100 feet deep, static level 15 feet -
untreated - 7 services - air pressure tank.

Analyses - February 19, 1974

Hardness	38 ppm
Alkalinity	206
Iron (Fe)	0.15
Chloride	16
pH	8.2
Fluoride	0.8
Color	< 5
Turbidity	0.55

2. HIGHGATE VILLAGE

Tape private water works system
drilled well - 7 services

Analyses - June 4, 1974

Hardness	40 ppm
Alkalinity	154
Iron (Fe)	0.04
Chloride	13
pH	7.8
Fluoride	0.9
Color	< 5
Turbidity	0.55

3. ORFORD TOWNSHIP

Highgate Pure water Supply System

Owned by 12 persons - 2 wells - drilled 6 feet into bedrock.
No. 1 well - 180 feet deep, 4" diameter, static level 96, pump capacity 450 gallons per hour, pressure tank.
No. 2 well - 193 feet deep, 4" diameter, static level 82.

Grant Private Water Works, Highgate Village

16 consumers - drilled well, 200 feet deep.

Analyses - February 11, 1974

Hardness	54 ppm
Alkalinity	149
Iron (Fe)	0.02
Chloride	63
pH	7.9
Fluoride	1.0
Color	5

Smith Private Water Works

14 consumers - well, 140 feet deep, 4" diameter, air pressure tank.

Analyses - February 11, 1974

Hardness	50 ppm
Alkalinity	153
Iron (Fe)	0.10
Chloride	6
Fluoride	0.9
pH	7.9
Color	< 5
Turbidity	1.4

4. DOVER TOWNSHIP

Proposal under consideration for Mitchell Bay area.

Burke Private Water Works

Drilled well - 6 services

Analyses

Hardness	58 ppm
Alkalinity	287
Iron (Fe)	0.20
Chloride	33
pH	7.7
Fluoride	1.0
Color	5
Turbidity	3.4

5. HARWICH TOWNSHIP

Murray Campbell Farm

8 services, 1 drilled and 1 dug well, chlorinated.

Analyses

Hardness	26 ppm
Alkalinity	287
Iron (Fe)	< 0.05
Chloride	126
pH	8.4
Fluoride	1.0

Marlborough Coloney Subdivision Lot 10 Concession 2

1 drilled well, 1 dug well, chlorinated, pressure tank, well depth 240 feet, static level 140 feet, rated 300 gallons per minute
Dug well - 35 feet deep, pump capacity 200 gallons per hour

Analyses - May 15, 1972

Hardness	12 ppm
Alkalinity	268
Iron (Fe)	0.05
Chloride	130
pH	8.5
Fluoride	1.8

Latter Day Saints Church Camp Water Works

Harwich Township - drilled well, pressure tanks, 50 buildings supplied.

Analyses

Hardness	98 ppm
Alkalinity	278
Iron (Fe)	0.3
Chloride	288
pH	7.8
Fluoride	1.5
Color	5
Turbidity	1.5

Charing Cross Hamlet Private Water Works - Raleigh Township

Well - 8 services

Analyses

Hardness	134 ppm
Alkalinity	216
Iron (Fe)	0.35
Chloride	442
pH	7.4
Fluoride	1.3

Rondeau Bay Estates Water Works - Harwich Township

2 wells: (a) 164 feet deep, and 4" diameter
(b) dry

Analyses - August 21st, 1973

Hardness	98 ppm
Alkalinity	223
Iron (Fe)	0.15
Chloride	653
pH	7.8
Color	< 5
Turbidity	1.8
SO_4	3

Erie Beach Private Water Works - Harwich Township

by Erie Service and Supply

2 drilled wells, 110 services, chlorination

Analyses - February 13, 1974

	No. 1 Well	No. 2 Well	
Hardness	88	82	ppm
Alkalinity	274	272	
Iron (Fe)	0.35	0.25	
Chloride	256	256	
pH	7.9	7.9	
Fluoride	0.8	0.8	
Color	10	5	
Turbidity	9.6	4.2	

Hardwich - Shrewsbury - Raglan area

System under consideration. 8 samples of existing wells mixed.

Analyses

Hardness	500 ppm
Chloride	250
Iron (Fe)	0.5
Fluoride	0.8 to 1.2

6. HOWARD TOWNSHIP

Winter's Private Water Works

Well - 152 feet deep, 3-1/2" diameter, pump capacity 250 gallons per hour - pressure tank.

Analyses

Hardness	641 ppm
Alkalinity	195
Iron (Fe	0.2
Chloride	63
pH	7.9

Howard Township continued

Summer Private Water Works

Well - 140 feet deep, 4" diameter, - 7 services

Analyses

Hardness	76 ppm
Alkalinity	212
Iron (Fe)	0.7
Chloride	85
SO_4	2.0
pH	7.8
Color	< 5
Turbidity	2.5

7. ORFORD TOWNSHIP

Neith (Muickerk) Private Water Works - 8 services

Analyses

Hardness	80 ppm
Alkalinity	120
Iron (Fe)	0.10
Chloride	134
Fluoride	1.2
Color	5
Turbidity	3

Duart MacPherson Private Water Works

12 consumers, well 154 feet deep, 4" diameter

Analyses - February 5, 1974

Hardness	64 ppm
Alkalinity	166
Iron (Fe)	0.10
Chloride	24
pH	8.4
Fluoride	1.0
Color	< 5
Turbidity	0.55

East-Muirkirk Private Water Works - Muirkirk Hamlet

Well - 178 feet deep, diameter 4-1/2" diameter, pump capacity 260 gallons per hour - pressure tank.

Analyses - July 21, 1975

Hardness	104 ppm
Alkalinity	110
Iron (Fe)	0.28
Chloride	176
pH	7.8
Fluoride	1.4

Campers' Cove Private Water Works - Romney Township

Well - no data

Analyses

Hardness	188	ppm
Alkalinity	119	
Iron (Fe)	0.10	
Chloride	22	
pH	7.7	
Color	< 5	
Turbidity	2.0	

Port Alma Water Supply - Tilbury East Township

Union Gas Company - Source Lake Erie.
Chiefly for cooling, part chlorinated for 10 company houses and 35 other homes

Analyses

Hardness	118	ppm
Alkalinity	86	
Iron (Fe)	1.1	
Chloride	20	
pH	8.1	

Glenwood Private Water Works - Tilbury East Township

Well - 180 feet deep, 4" diameter, pump capacity 400 gallons per hour, pressure tank

Analyses

Hardness	142	ppm
Alkalinity	142	
Iron (Fe)	0.4	
Chloride	810	
pH	8.0	

Port Crewe Private Water Works - Tilbury East Township

Source - Lake Erie, pumped to 2 settling reservoirs (41,300 gallon capacity) chlorinated, pressure tank.

Analyses

Hardness	144	ppm
Alkalinity	102	
Iron (Fe)	0.45	
Chloride	36	
pH	8.0	

Fletcher Private Water Works - Tilbury East Township

Well - 90 feet deep, 5" diameter

Analyses - March 13, 1973

Hardness	138 ppm
Alkalinity	170
Iron (Fe)	0.35
Chloride	640
pH	7.9

WATER ANALYSES

Analyses by the Ontario Water Resources Commission (Ministry of Environment) of municipal supplies are listed herewith:

1. CHATHAM

a) Thames River Water - Sample September 15, 1972

Raw Water

Hardness	256 ppm
Alkalinity	190
Iron (Fe)	1.95
Chloride	42
pH	7.9
Color	40
Turbidity	.80

b) Lake Erie Supply

Hardness	138 ppm
Alkalinity	86
Iron (Fe)	0.04
Chloride	26
Fluoride	0
Color	$<$ 5
Turbidity	0.9
pH	7.5

2. BLENHEIM

a) Raw Water - Lake Erie - February 25, 1974

Hardness	128 ppm
Alkalinity	92
Iron (Fe)	0.15
Chloride	20
pH	7.8
Fluoride	0
Color	$<$ 5
Turbidity	4.7

b) Raw Water - Average of analyses - period February 10, 1967 to June 26, 1972

Hardness	132 ppm
Alkalinity	92
Iron (Fe)	0.37
Chloride	23
pH	8.0
Color	19.6
Turbidity	7.5
Fluoride	0.2

3. DRESDEN

Raw Water - Sydenham River. Average period June 15, 1963 to June 20, 1967

Hardness	245 ppm
Alkalinity	178
Iron (Fe)	1.7
Chloride	17
pH	8
Color	35.7
Turbidity	32.5
Fluoride	0.2

4. RIDGETOWN

Well Water

	Raw Water	Treated Water	
Hardness	48	48	ppm
Alkalinity	151	152	
Iron (Fe)	0.1	0.1	
Chloride	23	23	
pH	8.1	8.1	
Fluoride	0.9	1.0	
Color	< 5	< 5	
Turbidity	1.1	1.1	

Average maximum and minimum of results for May 18, 1960 to June 21, 1972.

	Average	Maximum	Minimum	
Hardness	52	100	34	ppm
Alkalinity	160	178	146	
Iron (Fe)	0.14	0.30	0.00	
Chloride	23	25	20	
pH	8.2	8.4	7.8	
Color	2	2	2	
Turbidity	1	1	1	
Fluoride	1.6	1.7	1.4	

5. TILBURY

Raw Water - February 21, 1974

Hardness	298 ppm
Alkalinity	196
Iron (Fe)	1.9
Chloride	27
pH	7.6
Fluoride	0.3
Color	20
Turbidity	13
NO_3	4.3

6. WALLACEBURG

Raw Water - Average for period January 26, 1960 to May 1972

Hardness	105 ppm
Alkalinity	82
Iron (Fe)	0.72
Chloride	19
pH	8.0
Color	2.8
Turbidity	21.2

7. WHEATLEY

Raw Water - January 14, 1972

Hardness	120 ppm
Alkalinity	83
Iron (Fe)	0.50
Chloride	16.5
pH	8.1
Color	5
Turbidity	8

GROUND WATER ELEVATIONS

Static water levels are recorded for each well along with other data. This shows the vertical distance between the ground surface at the well and the water level in the well. The common base for comparison of these water elevations is the mean sea level (MSL).

To convert the water level to the MSL base, deduct the static level from the level of the ground surface. This result makes it convenient to compare water elevations, and to observe the available heads for drainage above the sea level.

OBSERVATION WELLS

The records of the water levels in the aquifers are noted in a number of ways. Municipally operated wells generally include these elevations in their records. This furnishes a substantial amount of information throughout the areas of the province. Well drilling operations also record the static levels, but these are not repeated.

Observation wells offer another facility for obtaining this information continuously or as often as desired. The Province records the data and makes it available.

In Kent County 7 of these observation wells are in use. They are: No. 217, Town of Bothwell well, diameter 6 inches, depth 150 feet, automatic recorder, March 1966.

Well No. 219

Near No. 217 - Town of Dresden, 4 inch diameter

Well No. 172

Town of Bothwell, 6 inch diameter, depth 34.5 feet. In the drainage area of Sydenham River - Automatic recorder 1966.

Well No. 309

Township of Tilbury East, diameter 6 feet, depth 23 feet, static level 5.02 feet.

Well No. 345

Town of Blenheim. drilled - 4 inch diameter

Well No. 371

Village of Thamesville - drilled - 6 inch diameter depth 67 feet, static level 23.96 feet. Automatic recorder.

The recorded water levels in these observation wells do not indicate any pronounced lowering of the water table. As in other instances, the levels tend to fluctuate up and down. This must be expected in wells.

POLLUTION STATUS OF GROUND WATER

At this time, there is no indication of surface pollution finding its way into the deep aquifers. At the same time it is important to so dispose of all wastes at the surface from various operations that the ground water will be protected and its quality preserved. This is conservation in its best sense.

SUMMARY AND CONCLUSIONS

GROUND WATER, COUNTY OF KENT

The following observations are based on information secured from several sources, with related interpretations. The ground water resource in Kent County has an important role to play.

(1) The records of wells, water resources, water quality and purification, and adequacy of supplies for the County's needs have been examined.

(2) Attention has been directed especially to municipal or public, industrial, and private water supplies.

(3) Water has been and will continue to be all important to the welfare of the people of the County.

(4) The focal point of the County for water needs is the City of Chatham. Selection was made a long time ago to use surface water, at that time the Thames River. A change has now been made to bring in a superior quality water from Lake Erie, with purification taking place at Chatham.

(5) The municipal or public water works systems serve a total population of approximately 65,000.

(6) The annual withdrawal of ground water for these public systems was 112 mg. When to this is added the withdrawal from wells for private use, it will be seen that a great reservoir is needed to balance the incoming and outgoing waters.

(7) In rural area, reliance is made on wells, now developed by drilling. With proper technique, no great difficulty has been experienced in getting sufficient water.

The chemical content in contrast to this is mostly high. Some of this is annoying but not dangerous to health. There is no undue problem as yet in controlling bacterial pollution. Chlorination is used as an added safeguard.

(8) A gratifying condition in so many of the waters of drilled wells is the presence of fluoride in amounts considered suitable for protection of teeth.

(9) There is no evidence as yet of man-made chemical pollution of deep wells, but care will be needed continuously to protect against this danger. The geologial formation may be subject to crevices which can carry pollutants long distances.

(10) The legislation for control of the water resources of the County is largely provincial in origin. It authorizes the local agencies to act.

(11) Conservation of ground water is essential in those parts of the County now drawing from deep wells. This means wise use of this resource.

(12) The extensive use of ground water in the rural county is shown by the tabulation of well drillings prepared by the Ministry of the Environment.

APPENDIX

7

COUNTY OF LAMBTON

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

1 9 7 7

CONTENTS

LAMBTON COUNTY

LAMBTON COUNTY

Bordered on the north by Lake Huron and on the west by St. Clair River, it would seem that water problems should be at a minimum. Certainly surface waters of good quality can be distributed throughout the entire County. The time for doing this must be decided as growth proceeds. Ground waters present a different problem. Quantity and quality are involved.

THE COUNTY

Lambton is substantial in area- 699,539.2 acres, relative to other counties. It is old in years of settlement and development. The Sarnia municipal water works system has been in operation since 1876. The position of the County presents great opportunities for distribution of water through inter-connected systems. In the meantime the smaller localsystems serve the water needs. A start has been made in making the Sarnia area the centre from which a Lambton County Water Supply System can spread its tentacles to many adjacent communities. In this it resembles the program of the Union Water System in Essex County.

The ground water program is different. The bedrock under the County limits the quantity of water in most areas, and it means high chemical contents, hardness as an example. Much effort has been made to obtain water from underground, some shallow, some deep. The records of these drillings will be recorded later herewith.

The land is mostly flat. The soil is good for agriculture. Canning crops are conspicuous. This mingles with the high industrial development in the Sarnia area. Water transportation is a great aid to the County.

DRAINAGE OF LAMBTON

The Sydenham River passes through part of the township en route to an outlet to Lake St. Clair. The elevations of the ground surfaces where many wells are drilled are about 600 and rising to over 700 in some areas. Surface drainage has always been feasible. Precipitation falling on the land has an opportunity to seep into the ground water reservoir. The soil is not ideal for penetration, and this affects the quantity of available water in the wells. Considerable difficulty has been experienced in some areas in getting sufficient ground water.

GEOLOGICAL FORMATIONS

Investigation of geological formations reveals that in most parts of the County the bedrock is composed of grey and black shales of the Devonian, Hamilton and Kettle Point formations. In the northeastern corner, the bedrock is limestones of the Devcnian, Delaware formation, and in the western part it consists of dark shales or sandstones of the Mississippian, Port Lambton formation. The bedrock of shales is generally poor for water supply.

Most of the overburden is glacial drift, mainly clays and clayey tills. Where the surface deposits are coarse grained, adequate domestic water supplies can be secured at shallow depths.

About 90 percent of the wells obtain water from the saturated sands and gravels on top of the bedrock. The thickness of the overburden varies between 0 and 200 feet, with an average range of 60 to 80 feet in the eastern part and 120 to 140 feet in the western part of the County.

Thus, it can be seen that the conditions related to the production of potable water are quite variable.

INDUSTRIAL NEEDS

While the use of water for domestic consumption must take the top priority, there is great need for industrial water. This requirement is particularly significant in this County where industry is concentrated along the Sarnia area waterfront. The breakdown of the assessment figures gives some indication of this. In the total County equalized assessment was 1,184,604,000 and the per capita assessment amounted to $10,376.

Must the water needs of the industrial and commercial activities be obtained from the surface or from the ground water? Where convenient access is to the surface water in the lake and river this will be the choice. If industry spreads inland recourse may be necessary to wells. This will be the case if the extension of watermains from the lake does not keep pace with industrial demands.

RURAL WATER SUPPLIES

The demand for water in the rural areas is great. Over one-third of the total population of the County resides in the townships. The needs of agriculture add much to the domestic requirements. The absence of suitable streams inland in the County places the burden on ground water.

The following data show the characteristics of some of the larger wells. These do not include the shallow dug wells. These are both rural and urban.

BOSANQUET TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM
Thedford P.U.C.	3	28	10	80	Flow	80
do	3	28	8	109	14	100
T. Crane		34	5	32	10	40
Grand Bend P.U.C.		5	11	124	23	27
DAWN TOWNSHIP						
C. Lassiline	11	34	4	70	20	25

ENNISKILLEN TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM	
D. Piggott	2	8	6	51	15	30	
W. Irwin	6	16	5	47	5	40	
MOORE TOWNSHIP							
Brigden P.U.C.	Many wells, either dry or low volume - depth to over 200 feet.						
PLYMPTON TOWNSHIP							
H. Jackson	7	7	4	125	42	180	
SOMBRA TOWNSHIP							
C. Salsbury	12	14	4	137	34	30	
G. Branton	12	23	4	120	20	30	
W. G. Robson	13	3	6	205	35	30	
WARWICK TOWNSHIP							
Watford P.U.C.	5	19	7	110	56	35	
do	6	18	8	110	59	35	
TOWN OF FOREST							
Forest P.U.C.	#1448		6	152	48	50	
do	#1447		6	150	48	50	
do	#1445		6	150	48	50	
do	#1449		10	132	48	75	
	Several other wells of low capacity						
ALVINSTON VILLAGE							
Alvinston P.U.C.	# 30		6	77	26	24	
COURTRIGHT VILLAGE							
Courtright Village	#3531		8	133	26	104	
do	#3532		2	174	25	37	
VILLAGE POINT-EDWARD							
P. U. C.	#2207		2	116	12	50	
P. U. C.	#2206		12	46	12	315	
P. U. C.	#2204		6	48	7	100	
LAMBTON COUNTY							
OWRC & County	#4066		12	65	11	800	
WATFORD VILLAGE							
Andrew Wire Works	#3208		6	116	60	33	Sulphur

Municipalities not listed did not have records of wells of substantial size. The small number of reasonable capacity wells shows the reliance on shallow wells of low rating each.

WATER LEGISLATION

The legislation concerning water works in Lambton County emanates primarily from the provincial level. This, in general, sets procedures to be followed and gives authority to local agencies. It has passed through long periods of time, with amendments being made as conditions called for.

The Ontario Water Resources Commission created in 1956, has in the interval played an important role in water works systems, in financing, building, and operating. Many new systems were built by the Commission and have been successfully operated by it. This program is now carried on by the Ministry of Environment.

Conservation Authorities have grown steadily since the legislation was passed. These Authorities are now in operation in nearly all parts of southwestern Ontario. In this County the St. Clair Region Conservation Authority covers the area.

No organized effort on a direct scale has been made to conserve the water resources of the County. Many public measures intended primarily for other purposes have affected water conservation. Wastewater purification and the control of water pollution are measures of importance here.

The control of water abstraction, both from the surface and underground, was a relatively new comer to this field. It is conservation in that it endeavors to prevent waste and also to divide the resource among those having some access to it.

POLLUTION POTENTIAL FOR WELLS

What can be regarded as water pollution? The pollutant must first get into the water. In considering the potential for pollutants to reach the water in wells, both shallow and deep, one must note the overburden of the rocks and the natural removal of wastes and foreign substances by filtration and adsorption. Deep

construction of wells is usually an effective barrier against bacterial contamination. This may not be effective against other wastes. Several factors may be at work in these formations; such as the composition of the aquifer and its overburden, travel distance, chemical reactions etc.

Pollutants are considered to be anything which interferes with the normal quality of the water. Thus such natural occurring substances as hardness, iron, sulphur and others are pollutants. They are picked up from the formations as the water passes through. They may remain fairly constant in quantity as will be seen from the analyses of the water over a period of time.

It is particularly important to know whether unnatural or man-made pollutants may reach the ground water. Some of these substances are both offensive and toxic. In an area where chemical and other waste products are present great care is needed to ensure that the defence barrier remains intact. Not a great deal can be done against natural pollutants except to remove them before the water is consumed or used.

PUBLIC WATER WORKS SYSTEMS

The following public water works systems are in operation. These systems are in the course of changes at present in an effort to assist a larger area rather than a single community:

Municipality or System	Date Constructed	Population Supplied	Water Source
Sarnia City	1876	55,031	St. Clair River
Forest Town		2,516	wells
Petrolia Town		4,201	Lake Huron
Alvinston Village		639	Sydenham River
Grand Bend Village		818	Lake - area scheme
Brigden P. Village			
Moore Township			wells
Do - Corunna			Surface - area scheme
Oil Springs		616	wells
Point Edward		2,490	Lake - Sarnia supply
Brights Grove			
Sarnia Township			Lake - area supply

Public Water Works Systems - continued

Municipality or System	Date Constructed	Population Supplied	Water Source
Port Lambton Village Sombra Township		400	St. Clair River
Thedford		656	wells
Watford		1,378	Lake - area supply
Wyoming		1,636	Lake - area supply

Under consideration at present are a number of changes which will alter the sources of supply. West Lambton and East Lambton projects are involved. The details on these are given later herewith.

Water supplies for the public systems in Lambton are as follows:

1. SARNIA

   Source of supply is the St. Clair River, with sedimentation, Chlorination and fluoridation.
   Pumpage (1973) 4,138.818 mg.
   Maximum day 25.1 mg.
   Minimum day 8.159 mg.

2. FOREST TOWN

   A system of shallow wells, with chlorine treatment. Water from main wells, Park Lane wells and South wells is delivered to a ground reservoir and to the distribution system.

3. ALVINSTON - Police Village

   Sydenham River - Physical and chemical treatment.

4. ARKONA

   Water from wells.
   Agreement now to be included in the major water supply for the County.

5. BRIGDEN - Police Village - Moore Township

   Wells

6. CORUNNA

   On Lambton area system

7. COURTRIGHT

   Lambton area system - lake water.

Public Water Works Systems - continued

8. GRAND BEND

Lake Huron water from Lambton area system

Analyses:

Hardness	96	ppm
Alkalinity	81	
Iron (Fe)	0.3	
Chloride	6	
Fluoride	0.7	
pH	7.9	

9. OIL SPRINGS

3 deep wells - direct pumpage to system

Well #1 - 14,731 gallons per day - average
Well #3 - 3,660 gallons per day - average
Well #4 - 6,244 gallons per day - average
Chlorination of supply. Pumpage, total 1974 - 8,992,000 gallons (see analyses)
It is proposed to abandon these works when the Lambton systems are in operation.

10. POINT EDWARD VILLAGE

Sarnia system - River supply.

11. THEDORD VILLAGE

Source - two wells - new unit 1-1/2 miles north of village used regularly while the old well is used periodically, chiefly as a standby.
Pumpage - 1973 - 18,440,000 gallons. Population 700 (see analyses)

12. WATFORD

Supply from Bright's Grove off line to Petrolia - Gravity
Population 1,378

13. WYOMING

Supply from Petrolia pipe line from Bright's Grove
Population 1,636

14. SOMBRA VILLAGE

St. Clair River - Chlorinated (see analyses)

INDUSTRIAL WELL SUPPLIES

Well supplies for industrial purposes are not significant in the County. The concentration of industry adjacent to surface waters makes this the source of choice.

PRIVATE WATER WORKS SYSTEMS

The following list is for private or small water works systems. Most of them are privately owned, but a few are operated by the municipalities.

1. BOSANQUET TOWNSHIP

Source - wells

Analyses - May 28, 1975

Hardness	220 ppm
Alkalinity	217
Iron (Fe)	0.08
Chloride	10.5
pH	7.48
Fluoride	0.1
Color	15
Turbidity	0.38
SO_4	3.5
Nitrate	8.2

Cedar View Water Works

Sand point on Lake Huron - Chlorination

Analyses - July 13, 1971

Hardness	108 ppm
Alkalinity	82
Iron (Fe)	0.55
Chloride	7
pH	7.8
Fluoride	0.2
Color	10
Turbidity	8

Lakeview Haven Subdivision Water Works

Source - Well - 6" diameter, depth 81 feet - no treatment.
13 cottages on East side of Lakeview Road
Static level 58, pressure tank

Analyses - July 14, 1971

Hardness	80 ppm
Alkalinity	386
Iron (Fe)	0.10
Chloride	260
pH	8.0
Fluoride	1.4
Color	< 5
Turbidity	1.0

Private Water Works Systems - continued

1. Bosanquet Township - continued

J. Van Dongen Subdivision Water Works

Now operated by Township of Bosanquet. Well

Analyses - November 2, 1971

Hardness	284	ppm
Alkalinity	206	
Iron (Fe)	< 0.05	
pH	7.6	
Fluoride	0	

Kettle Point Lodge Water Works

Source - Sand point on Lake Huron. Chlorinated.
7 cottages

Analyses - July 18, 1972

Hardness	120	ppm
Alkalinity	108	
Iron (Fe)	0.4	
pH	7.8	
Chloride	14	
Color	10	
Turbidity	2	

Pinehurst Trailer Park Water Works

Source - Ground water via 1 - 6" diameter, 36 feet deep and
1 - 4" diameter, 35 feet deep. Chlorinated

Analyses - June 16, 1975

Hardness	278	ppm
Alkalinity	242	
Iron (Fe)	1.12	
Chloride	30	
pH	7.37	
Fluoride	< 0.1	
Color	10	
SO_4	13	

Port Franks Water Works

Agreement proposal.

Parkside Trailer Park Water Works

Shallow sand points - 5 trailer sites

Analyses - August 7, 1975

Hardness	182	ppm
Alkalinity	161	
Iron (Fe)	0.08	

Private Water Works Systems - continued

1. Bosanquet Township - continued

Parkside Trailer Park Water Works - continued

Chloride	2
pH	7.4
Fluoride	< 0.1
Color	5

Sunnyside Trailer Park Water Works

South Points - 2 shallow sand points - 15 sites
North Points - 3 shallow sand points - 17 sites

Analyses - August 7, 1975

	South Points	North Points	
Hardness	274	314	ppm
Alkalinity	208	210	
Iron (Fe)	0.54	0.42	
Chloride	52	52	
pH	7.72	7.57	
Fluoride	< 0.1	< 0.1	
Color	15	15	
Turbidity	1.7	1.1	
SO_4	15	15	

Other Private Water Works in Bosanquet Township

1. Campout Trailer Park - Shallow well points
2. Pineview Trailer Park - Shallow well
3. Camp Bosanquet - deep well points
   Hardness 70, Alkalinity 388, Iron (Fe) 0.28, Chloride 200
4. Kit-Kat Trailer Park - drilled well - chlorinated, aerated, filtered. Raw water analyses - hardness 344, Alkalinity 316, Iron (Fe) 5.24, Chloride 5, pH 7.48 Color 150 and Turbidity 18.
5. Cedar View Subdivision - Infiltration well - chlorinated. Hardness 182, Alkalinity 137, Iron (Fe) 0.04, Chloride 9.5, pH 7.55, Color 15, Turbidity 0.15
6. Lambton United Church Centre - Lake infiltration well - shallow - chlorination.
7. Forest Cliff Camps - Deep well point - chlorinated. Hardness 70, Iron (Fe) 0.2, Chloride 360, Color 5, Turbidity 2.4
8. Orchard View Trailer Park - Lake Huron - sand filter and chlorination
9. Rendezvous Trailer Park - 22 feet deep well - Hardness 304, Iron (Fe) 0.2, Alkalinity 239, Fluoride < 0.1, Color < 5, Turbidity 12.
10. Our Ponderosa Ltd. - well - Hardness 328, Alkalinity 254 Iron (Fe) 0.05, Chloride 20, Color 10, Turbidity 0.35 SO_4 40.

Note: (Several other small systems in operation)

Private Water Works Systems - continued

1. Bosanquet Township - continued - Other Private Water Works

11. Ipperwash Trailer Park - well - Hardness 258, Alkalinity 213, Iron (Fe) 0.30, Chloride 21, pH 7.6
12. Camp Ipperwash, Military Camp - source Lake Huron, sedimentation plus chlorination. Hardness 102, Alkalinity 30, Iron (Fe) 0.30, Chloride 9, Color 5 and Turbidity 6.1.

2. TOWNSHIP OF DAWN

Oakdale Water Works - 15 services, Well 61 feet.

Analyses - February 7, 1974

Hardness	62	ppm
Alkalinity	280	
Iron (Fe)	0.40	
Chloride	114	
pH	8.0	
Fluoride	1.0	
Color	< 5	
Turbidity	2.2	

Rutherford Water Works - Well 34 feet - 4 inch casing

Analyses - March 28, 1973

Hardness	106	ppm
Alkalinity	358	
Iron (Fe)	0.3	
Chloride	93	
pH	7.8	
Color	< 5	
Turbidity	2.0	

3. MOORE TOWNSHIP

Stag Island Water Works - St. Clair River, Chlorination, 104 services

Analyses - September 5, 1974

Hardness	116	ppm
Alkalinity	79	
Iron (Fe)	0.05	
Chloride	6.8	
pH	7.9	
Color	< 5	
Turbidity	1.3	

4. PLYMPTON TOWNSHIP

Point View Subdivision Water Works - Sandpoint on Lake Huron

Private Water Works Systems - continued

4. Plympton Township - continued

Point View Subdivision Water Works - continued

Analyses - February 27, 1974

Hardness	292	ppm
Alkalinity	203	
Iron (Fe)	< 0.05	
Chloride	8	
pH	7.3	
Color	15	
Turbidity	0.5	

Hillsboro Subdivision Water Works

Analyses -

Hardness	80	ppm
Alkalinity	334	
Iron (Fe)	0.3	
Chloride	157	
pH	7.8	
Color	5	
Turbidity	1.6	

Gallimere II Water Works

Analyses -

Hardness	134	ppm
Alkalinity	347	
Chloride	372	
pH	7.5	
Color	10	
Turbidity	3.5	
Fluoride	1.5	

Gallimere Beach Water Works

Analyses - June 22, 1973

Hardness	76	ppm
Alkalinity	301	
Iron (Fe)	0.2	
Chloride	107	
pH	7.8	
Color	< 5	
Fluoride	1.5	

Blue Point Bay Water Works

Analyses - June 21, 1973

Hardness	76	ppm
Alkalinity	332	
Iron (Fe)	0.2	
Chloride	96	
pH	7.9	
Color	< 5	
Turbidity	1.3	

Private Water Works Systems - continued

4. Plympton Township - continued

Point View Subdivision Water Works - Lake Huron

Analyses - June 21, 1973

Hardness	176 ppm
Alkalinity	132
Iron (Fe)	0.35
Chloride	8
pH	7.8
Color	5
Turbidity	4.9

5. SOMBRA TOWNSHIP

Chinook Chemicals Corporation Water Works

St. Clair River - Chlorination

Analyses - February 27, 1974

Hardness	114 ppm
Alkalinity	86
Iron (Fe)	0.30
Chloride	20
pH	7.6
Color	10
Turbidity	8.2

Fawn Island Water Works -

St. Clair River - chlorinated - 37 services

Analyses - June 20, 1973

Hardness	100 ppm
Alkalinity	82
Iron (Fe)	0.10
Chloride	13
pH	8.2
Turbidity	1.5

C.I.L. Water Works - St. Clair River - Chlorinated

Analyses - October 19, 1972

Hardness	100 ppm
Alkalinity	78
Iron (Fe)	0.20
pH	8.3
Fluoride	0
Color	5
Turbidity	3

WATER ANALYSES

Analytical data on the municipal water supplies are listed herewith. The major sources are surface supplies, but it is desirable to include both for ready comparison of the products.

1. SARNIA SUPPLY - St. Clair River supply

Analyses - March 21, 1974

	Raw Water
Hardness	102 ppm
Alkalinity	78
Iron (Fe)	0.05
Chloride	6
pH	7.8
Fluoride	0
Turbidity	2.0

Fluoridation is in effect on the treated supply.

2. FOREST

Analyses -

	Main Pumphouse	Parklane Well	South Wells
Hardness	108	118	82 ppm
Alkalinity	367	353	361
Iron (Fe)	0.2	2.6	0.59
Chloride	154	102	98
pH	8.2	8.0	8.3
Fluoride	1.8	1.6	1.8
Color	< 5	< 5	< 5
Turbidity	0.6	6.9	1.6

3. PETROLIA

Bright's Grove supply from Lake Huron

	Raw	Treated
Hardness	100	104 ppm
Alkalinity	82	82
Iron (Fe)	0.05	0.05
Chloride	6	7
pH	8.0	7.8
Color	< 5	< 5
Turbidity	2.1	1.9

Water Analyses - continued

4. OIL SPRINGS

Analyses - January 8, 1975

	#1 Well	#3 Well	#4 Well	Distribution
Hardness	74	76	78	78 ppm
Alkalinity	350	352	345	349
Iron (Fe)	0.3	0.85	0.35	0.35
Chloride	125	135	120	120
pH	7.9	8.0	8.0	7.9
Color	< 5	< 5	< 5	< 5
Turbidity	1.9	0.75	1.3	2.5

5. THEDFORD

Analyses - June 28, 1972

	New Well	Old Well	Distribution System
Hardness	96	90	90 ppm
Alkalinity	204	204	208
Iron (Fe)	0.35	0.15	0.25
Chloride	22	30	32
pH	8.0	7.8	7.9
Fluoride	2.0	2.0	2.0

6. SOMBRA

Analyses - February 6, 1974

	At Pumphouse
Hardness	122 ppm
Alkalinity	80
Iron (Fe)	0.05
Chloride	14
pH	8.1
Fluoride	0
Color	< 5
Turbidity	1.9

(downstream from Sarnia)

A comparison of the analyses from the various sources offers some wide variations.

Hardness in the surface samples is approximately 100 while the ground water at Forest shows 82 to 118, and at Oil Springs, 74 to 78 ppm; Thedford 90 to 96 ppm. Thus, the wells in the above municipalitieswere no harder than the surface supply. It appears

that the hardness is likely to vary a good deal with the locality of the aquifer.

The iron content in surface water was low at 0.05. The Oil Springs wells ranged from 0.3 to 0.85, somewhat above the standard. At Thedford it was on the border line.

The Chloride content was low in the surface, while at Forest it ranged from 98 to 154, somewhat high but within recognized limits.

The fluoride content in the surface supply was absent, while the well waters varied from 1.6 to 1.8 ppm in Forest as compared to a standard of 1.0 ppm. These fluoride figures for ground water are somewhat surprising as it was not known that fluoride was present in such quantities as to be beneficial in the protection of teeth.

GROUND WATER ELEVATIONS

The government's records for wells show, inter alia, the static water level and the level of the ground where the well is sunk. This makes it possible to compute the static level to mean sea level. While the overburden and the rock surfaces are complex formations, these levels may offer some aid in examining the relationships among the wells and the slopes from the wells to the sea level.

As an example, a well in Thedford has a depth of 100 feet, a static level 14 feet below ground surface and a ground elevation of 595 (based on sea level). This means that the static level of the water in that well is 581 feet above sea level.

Compare this with a well in Alvinston at a ground level of 720, a static level of 26 feet, and a depth of 77 feet. This converts to a static level of 694 feet for a difference of 113 feet. What is involved in the overburden or rocks to cause this?

Similarly a well at Courtright has a static level of 564 mean sea level; one at Forest shows 625 feet, and another at Point Edward at 592 feet; one at Brigden as 550 feet, etc.

OBSERVATION WELLS

The Province supervises two observation wells in th county. Numbers 56, and 207, the former in the pumphouse at Forest, at a depth of 110 feet, and the other in the village of Alvinston in the drainage area of Sydenham River, and having a total depth of 78 feet. These records reveal irregularities and a relationship with precipitation but no apparent permanent lowering of the water levels. Two factors are expected to affect these levels, viz, precipitation and withdrawal.

POLLUTION STATUS OF WELL WATERS

At present, there is no indication of unnatural pollution of these ground waters. If any is present it has not yet been identified with any source which can penetrate the overburden.

There is an ever present danger of pollution of the aquifer. It is contrary to The Public Health Act to use an abandoned well for disposal of waste water. Similarly, great care will be needed to protect against all man-made sources of pollution. Periodic surveys and analyses are called for.

DEEP WELL DISPOSAL

The discharge of concentrated liquid wastes into deep formations much below the fresh water aquifers is an entirely different situation. Some industries producing wastes highly difficult to purify have resorted to this method of disposal. The wastes are pumped under pressure into the formation where they spread out. These operations require considerable care.

In Lambton County the use of deep wells for disposal has been practiced to some extent.

SUMMARY AND CONCLUSIONS

LAMBTON COUNTY WATER CONSERVATION

The following summary and conclusions are based on information secured from several sources.

(1) The records of wells, water resources, water quality and purification, and adequacy of supplies for the County's needs have been examined.

(2) Particular attention has been directed to municipal, public, industrial and private supplies.

(3) The County has experienced difficulties in obtaining adequate supplies of ground water of suitable quality. The area is not one in which too much reliance can be placed on wells, although some sections are at present securing sufficient supplies.

(4) The County of Lambton is fortunate in having within an economic range surface water supplies, which after treatment can readily meet standards for domestic consumption.

(5) Both surface and well supplies are in use by urban centres. The programs now going forward provide for extending surface waters to ever-growing populations in the County. This is highly desirable under the circumstances.

(6) The amount of ground water withdrawn from the underground reservoirs in the County is not known and is no doubt much less than in some counties.

(7) Conservation, i.e. the wise use, of ground water is important for the inland areas and in those sections which cannot be expected to be on a major pipeline hook-up for some time.

(8) There is no specific evidence as yet of surface pollutants reaching the aquifers. The control of these wastes, both on the surface and in deep well disposal calls for a high priority.

(9) Protection of surface waters against man-made pollutants is a strong conservation argument. Energetic action at all times is essential.

APPENDIX

8

COUNTY OF MIDDLESEX

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

1 9 7 7

CONTENTS

COUNTY OF MIDDLESEX

MIDDLESEX COUNTY

The inland County of Middlesex has many unique features. It is a leading part of southwestern Ontario. It has the aggressive University of Western Ontario. Its rapid growth in population and industrial expansion calls for a corresponding water supply of highest quality. The County is a centre of agriculture and industry.

THE COUNTY

The County has an area of over 812,518.4 acres, with the core being the enlarged City of London. Two towns and six villages make up the urban section. There are 15 townships. The overall population of the County was 304,824, with 243,824 or 80% in London city. The towns and villages had a population of 13,312 or only 4% of the total, leaving the townships with 45,436 or 14.9% of the total. Thus the focal point for growth and activity is in the London area.

The City of London has an interesting water works history. A public system has been in operation since 1878. Numerous problems have been faced in order to provide water for a rapidly growing city. Dr. E. V. Buchanan, a former utility manager records this struggle in an interesting book.

The total area of the County of 812,518 acres, has seen many changes in municipal boundaries since the original lines were set.

This compares with Lambton's 699,539.2 acres, and Elgin's 464,518.4 acres, and Huron's 840,832 acres. The large size of the County with its inland location poses severe problems in water supply.

This land-locked area is composed of 15 townships in which are located a number of communities ranging in sizes. Many of today's communities date from the beginnings of settlement at a time when the

waterways provided the means of access. The forests had to be cleared to make way for the communities. The land is rich for agricultural uses.

This growing area has had to plan vigorously for water supply development to keep pace with growth.

DRAINAGE OF THE LAND

The Thames River is the great drainage outlet for the County, with the north and south branches. The Au Sable and Sydenham Rivers also play a role so that drainage can be carried off with little difficulty.

The Upper Thames River Conservation Authority has been active in Middlesex County. To what extent these different water courses contribute to the underground supply is not known, but they can be considered as signally beneficial.

GEOLOGY OF THE COUNTY

The quality of ground water is closely related to the geological formations of the area. In Geological Circular 13 on "Rocks and Minerals of Ontario" the following is stated - "All of southern and southwestern Ontario, south of a line extending from Midland on Georgian Bay to Kingston on Lake Ontario, and west of the Frontenac Axis, is underlain by Paleozoic rocks. These Paleozoic formations also extend up the Bruce Peninsula and across into Manitoulin, Cockburn and St. Joseph Islands."

Limestone and dolomite prevail in much of the County. Under these conditions water with high hardness and other chemicals can be expected.

A comparison of the analyses of the different waters reflects the geology of the area. Deep wells collect much dissolved material from the soil and rocks. This is a natural phenomenon and little can be done about changing the contents.

INDUSTRIAL NEEDS

In any city the size of London there will likely be a high industrial demand. This steps up the overall requirements for the community, and London, until of recent years relied on ground water. Many wells were sunk. Finally a decision was made to take water from Lake Huron. This supplies not only the City but is also available for smaller centres along the pipeline. This almost inexhautible supply of water can satisfy industries as well as domestic needs.

The Lake Huron supply was supplemented later by a pipeline from Lake Erie to supply the new plant of the Ford Motor Co. at Lambeth and the City of St. Thomas.

These lake supplies are now available for industries in the whole area, and the works can be enlarged as required.

RURAL WATER SUPPLIES

There is a constant demand for water in the rural agricultural areas. This is expected to come from wells. Difficulties have been encountered in a number of these places, especially in times of prolonged dry spells. Recourse may be had to deepening the existing wells in some instances. The smaller urban centres along the lines look to supplies under government assistance from the lake waters.

Irrigation was not a feature of the design of the pipelines, but as time goes on, this may become a more common practice. The base work is at least available to meet these ultimate needs.

WELL DRILLING RECORDS

The following data show some of the characteristics of some of the larger or more significant drilled wells in the County. Most of them are for rural use, but details are also included for the small urban centres.

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM	
ADELAIDE TOWNSHIP							
London P.U.C.	3	26	2	30	4	45	
London P.U.C.	3	26	2	30	3	60	
Strathroy Town	1	28	6		45	20	
do	1	28	6	85	45	20	
do	3	27	6	100	5	40	
T. Aarts	2	18	5	80	12	59	
BIDDULPH TOWNSHIP							
Lucan Village	1	31	10	68	30	120	
Dept. of Defence	4	7	6	42		38	
do	4	7	6	38	2	35	
Western Ont. University	Many shallow wells						
CARADOC TOWNSHIP							
C. Mostrey	3	21	6	88	22	30	
Roy Bros.	9	12	4	48	12	30	
DELAWARE TOWNSHIP							
London P.U.C.	Numerous 5" test holes in this township						
Sunhaven Nursing Home	3A		7	192	70	30	
J. H. Moore	4	2	7	130	63	40	
London P.U.C.	4	3	26	99	11	1050	
do	4	3	8	108	11	166	
do	4	3	2	88	10	319	
do	4	3	8	125	28	105	
EKFRID TOWNSHIP							
M. Leatch	5	21	6	92	14	30	
GLENCOE P.U.C.	23		7	121	9	30	
do	24		7	110	26	30	
Melbourne-OWRC	1	4		170	8	34	
do	1	4	7	173	8	80	
GLENCOE VILLAGE							
	A number of dry or low wells						
LOBO TOWNSHIP							
London P.U.C.	1	4	8	90	Flow	200	
do	1	6	10	81	9	30	Sulphur
do	1	7	16	81	22	1200	Sulphur
do	1	7	38	67	12	1500	
do	1	7	6	73	11	135	Sulphur
do	1	7	38	74	14	1800	
do	1	7	12	72	10	700	Sulphur
do	1	7	38	76	16	2000	
do	1	7	38	70	18	1400	

LONDON CITY

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (Ft)	STATIC LEVEL	RATED GPM	
London P.U.C.	#3977		26	90	17	1836	
Western Ont. Univ.	#1290		10	177	Flow	254	Sulphur
J. Labatt	#1292		8	140	76	206	Sulphur
Robinson Industries	#1286		6	300	22	100	Sulphur
Wyatt	#1146			118	46	167	
McCormicks	#1144			104	24	127	
Ontario Hospital	#1288		8	175	102	85	Sulphur
Coleman Pkg. Co.	#1287		10	127	70	64	
P.U.C.	#1311		12	134	21	600	
P.U.C.	#1261		26	70	2	1015	
P.U.C.	#1262		26	137	72	400	
P.U.C.	#1266		26	85	43	173	
P.U.C.	#1267		24	92	1	125	
P.U.C.	#1268		30	54		160	
Kellog Co.	#1270		12	242	37	250	
P.U.C.	#1271		26	123		425	
Famous Players	#1276		10	378	35	200	
Matthews Group	#4700		6	72	32	50	
P.U.C.	#1275		26	137		900	
Dept. of Transport	#1278		10	87	44	35	
Kellog Co.	#1280			290	49	87	
Central Aircraft	#1281		14	104	22	221	
Coleman Pkg. Co.	#1357		7	117	75	40	

Many well holes sunk by P.U.C.

LONDON TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (Ft)	STATIC LEVEL	RATED GPM	
P.U.C.	1	21	8	67	4	75	
P.U.C.	1	21	26	54	9	605	
Dept. of Transport	2	1	8	105	40	141	
Can.Minnesota Mining	2	5	10	253	47	335	
do	2	5	10	269	47	435	
P.U.C.	2	25	4	143	5	106	
P.U.C.	2	26	4	125	8	180	
P.U.C.	2	26	12	120	11	845	
Upper Thames River Conservation Authority	3	3	6	84	45	35	
P.U.C.	3	8	8	59	2	45	
P.U.C.	3	8	26	38	6	325	
P.U.C.	3	9	8	60	3	45	
P.U.C.	3	9	8	62	4	85	
P.U.C.	3	10	8	112	20	60	
P.U.C.	3	12	36	70	8	205	
P.U.C.	3	13	24	73		363	
P.U.C.	3	13	26	79	35	205	
P.U.C.	3	13	7	50	9	85	
P.U.C.	3	15		60	Flow	347	Sulphur
C. Pocock	3	18	5	122	21	140	
P.U.C.	4	8	7	77	28	40	
P.U.C.	4	8	16	59	19	833	
P.U.C.	4	9	8	76	4	60	
P.U.C.	4	12	7	93	3	100	
Wards Water Supply	4	13	3	27	10	50	
do	4	13	3	27	10	30	
do	4	13	3	27	10	50	

London Township - continued

OWNER	CON No.	LOT No.	DIA. (Inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM
J. Smallman	4	17	10	48	2	125
P.U.C.	5	4	4	46	2	73
P.U.C.	5	4	2	48	6	64
P.U.C.	5	4	4	46	2	63
P.U.C.	5	4	38	45	4	101
P.U.C.	5	4	38	41	3	1066
P.U.C.	5	4	38	49	3	1100
P.U.C.	5	4	20	50	16	800
P.U.C.	5	4	4	68	4	63
Matthews Group	5	4	10	68	31	400
do	5	4	5	70	31	60
do	5	4	7	63	31	50
P.U.C.	5	5	10	40	4	330
Agric. Chemicals	5	25	7	146	4	30
P.U.C.	6	1	2	36	4	108
Middlesex School	6	16	6	48	18	45
Holland	6	17	5	155		180
P.U.C.	6	18	4	126	3	52
J. Stevens	7	16	7	150	55	40
D. Wilden	7	17	8	179	48	175
W. Langdon	7	26	36	17	2	50
P.U.C.	7	21	4	197	50	102
P.U.C.	7	27	4	183	5	36
P.U.C.	7	27	4	183	10	102
E. Whalley	8	18	6	179	60	60
L. Stokes	9	19	36	52	20	60
P.U.C.	C	1	14	500	36	423
METCALFE TOWNSHIP						
W. Butlery	4	10	4	115	30	30
S. Marko	14	7	7	91	13	30
MOSA TOWNSHIP						
M. Little	1	1	6	220	25	45
NEWBURY TOWNSHIP						
Newbury Hospital	#2771		7	38	6	40
do	#2769		7	40	7	40
NORTH DORCHESTER TOWNSHIP						
R. Given	1	6	4	125	55	30
P.U.C.	Many wells - 5" to 10" - sunk - data missing					
E. Miller	5	5	4	48	30	300
P.U.C.	Wells 1" to 10", depth about 50 feet.					
Imperial Oil	1	19	5	105	55	40
M. Johnson	6	3	5	182	50	60

PARKHILL TOWN

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM	
P.U.C. (Town)	#3158		10	193	95	130	
P.U.C. "	#3159		10	200	95	106	

STRATHROY TOWN

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM	
P.U.C.	#3180		6	64	3	56	
P.U.C.	#4521		2	32	3	45	
P.U.C.	#3178		6	43	8	45	
P.U.C.	#3171		6	71	3	105	
P.U.C.	#4519		2	31	6	38	
P.U.C.	#3162		30	28	10	100	

WEST NISSOURI TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM	
Somerville Industry	1	2	8	103	28	90	
A. Douglas	2	1	5	93	16	240	
P.U.C. (London)	2	11	8	52	Flow	23	
P.U.C. "	2	12	2	67	Flow	220	
Tom Prendergast	2	19	5	173	75	50	
P. Socan	4	1	4	89	2	40	
P.U.C. (London)	4	19	10	236	32	450	

WESTMINSTER TOWNSHIP

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM	
P.U.C. (London)		35	5	87	5	31	
H. Mackenzie	1	29	8	112	94	125	
P.U.C.	1	49	5	104	20	30	
HEPC	2	18	7	154	41	35	
N. Spivack Co.	2	36	4	46	7	30	
Produce Supply Co.	2	37	8	196	75	20	
do	2	37	8	220	58	40	
do	2	38	6	193	70	65	
Treasure Island Property	3	15	7	151	50	30	
do	3	15	5	180	30	30	
do	3	15	8	180	30	100	
Northern Electric Co.	3	15	10	406	43	225	Sulphur
Towers Store	3	16	8	158	26	70	
BP of Canada	3	16	5	149	58	30	
R.C. Seminary	5	15	7	200	68	60	
P.U.C. (London)	5	16	4	320	113	60	Sulphur
do	5	17	4	201	76	55	
do	5	17	26	188	80	1480	
do	5	19		145	29	388	
do	5	19	8	133	28	30	
do	5	19		135	26	170	
do	5	19	8	133	39	400	
do	5	19	26	131	64	1020	
do	5	20	26	176	76	1025	
do	5	21	10	80	9	531	
do	5	21	10	103	21	400	
do	5	21	10	133	20	87	
do	5	21	8	180	63	210	
do	5	21	26	163	65	809	
do	5	22	10	144	Flow	700	

Westminister Township - continued

OWNER	CON No.	LOT No.	DIA. (inches)	DEPTH (ft)	STATIC LEVEL	RATED GPM	
P.U.C. (London)	5	20	26	202	93	800	
do	6	21	16	208	97	1000	
Dept. of Highways	5	59	6	325	91	50	Sulphur
Lambeth Village		68	4	152	67	30	
Superior Conc.		73	7	124	40	50	
J. Weisteinde		74	5	130	84	30	
Lucy Vande Velden		71	5	124	67	30	
P.U.C.	#4504		26	255	70	900	
P.U.C.	#4505	77	26	126	92	785	
P.U.C.	#3976	78		79	24	75	

WATER LEGISLATION

The administration of water works in Middlesex County is supported by appropriate legislation, most being at the provincial level. This legislation provides authority and sets limitations for local administrative bodies. This is similar to that in use elsewhere in the province.

The creation of the Ontario Water Resources Commission in 1956 enabled the province to finance and operated certain water projects. This was the case with the supply works bringing water from Lake Huron to the City of London.

Also contained in the Provincial legislation are: The Conservation Authorities Act, the construction of dams, and the control of water abstractions, both surface and underground. These enactments have proven beneficial for local needs. They continue to serve and are kept up to date by amendments through the Ontario Legislature.

CONSERVATION AUTHORITIES

Provincial legislation for the creation of Conservation Authorities has been well established. Now, most of the province is included in the jurisdiction of conservation authorities.

The objective of the Conservation Authorities is the wise management of the renewable natural resources. Ground water becomes an important resource in this program. By delaying and minimizing the floods better use is made of the water. Storage reservoirs not only reduce flooding conditions but also make available in dry seasons water for other purposes.

In the County of Middlesex, two conservation authorities operate - The Upper Thames, and the Lower Thames Conservation Authorities, both dealing with the Thames River

WELL DATA

Information has been collected for the County on water development and use, particularly on ground water. These data are tabulated herewith and interpretation of this material has been made and recorded herein.

Records compiled by the Ontario Water Resources Commission (now a branch of the Ministry of Environment) are listed herewith in summary form.

Total wells drilled	6,679
Ending in overburden	4,744
Ending in bedrock	1,922
Kinds of water;	
Fresh	4,907
Salt	16
Sulphur	339
Mineral	24
Dry hole	472

Water Use	
Domestic or live stock	4,582
Irrigation	43
Industrial	84
Commercial	162
Municipal	66
Public supply	152
Cooling	6
Not used	452
Test hole	918
Abandoned	697

PUBLIC WATER WORKS SYSTEMS

The following municipal water works systems are in operation:

Municipality	Date Constructed	Population Supplied	Water Source
London City	1878	243,928	Lake Huron
Parkhill Town	1913	1,281	(formerly ground water)
Strathroy Town	1903	7,471	Wells and sand points

Public Water Works Systems - continued

Municipality	Date Constructed	Population Supplied	Water Source Source
Ailsa Craig Village		659	Lake Huron
Glencoe Village		1,752	wells
Lucan Village		1,383	wells
Wardville Village		400	private wells
Lambeth		2,720	wells
Dorchester Pol.Village		1,150	wells

In addition to the above - parts of townships have systems in operation - mostly under private ownership

Additional information on the water supplies for the public systems is listed herewith:

1. LONDON

Area - 39,648 acres, population 243,928
The water supply now comes from Lake Huron. It is filtered and disinfected and pumped through a pipeline to London and may be available to communities along the route.
- see analyses

2. PARKHILL

Source - Lake Huron system - formerly wells

3. STRATHROY

Area 2,125 acres, population 7,500
The supply is obtained from ground water - 7 pumping stations containing 70 sand points and one 10 inch shallow well - no treatment - 2078 services - ground level reservoir of 129,400 gallons plus an elevated tank of 416,500 gallons.
Total pumpage (1974) - 190,622,100 gallons.
The wells are operated in sequence:

Section 1 (Francis Street) 10 sandpoints, depth to top of screen - 25 feet.
Section 2 (Francis Street) 10 sandpoints, depth to top of screen - 22 feet.
Section 3 (Francis Street) 10 sandpoints, depth to top of screen - 22 feet.
Section 4 (English Street) 10 sandpoints, depth to screen 22 feet
Section 5 (High Street) 10 sandpoints, depth to screen 22 feet
Section 6 (Oxford Street) 10 inch diameter steel cased well to approximately 35 feet.

- see analyses

4. AILSA CRAIG

Lake Huron water system

WATER ANALYSES

1. LONDON - GRAND BEND

System on Lake Huron

2. PARKHILL TOWN

Hardness	248 ppm
Alkalinity	192
Iron (Fe)	0.15
Chloride	6
Fluoride	0
Color	< 0.05
Turbidity (units)	0.25
pH	7.5

3. STRATHROY - Wells

Hardness	270 ppm
Alkalinity	226
Iron (Fe)	< 0.05
Chloride	8
Fluoride	0
Color	< 5
Turbidity (units)	0.3
pH	7.7

4. AILSA CRAIG VILLAGE - Lake Huron Supply

5. GLENCOE VILLAGE - Wells

Hardness	316 ppm
Alkalinity	253
Iron (Fe)	0.95
Chloride	65
Fluoride	2.4
Color	5
Turbidity (units)	3.7
pH	7.8

6. LUCAN VILLAGE - Wells

Hardness	282 ppm
Alkalinity	250
Iron (Fe	0.50
Chloride	4
Fluoride	0.4
Color	< 5
Turbidity (units	1.6
pH	7.7

7. WARDVILLE VILLAGE - Wells - private

Village supplied by Gardiner Communal Water Supply System. Well - 115 feet deep 7" diameter - no treatment - 25 residences - 20 gpm rated - no storage except at private residences - See analyses

Water Analyses - continued

8. LAMBETH VILLAGE - Wells

Hardness	248 ppm
Alkalinity	192
Iron (Fe)	0.15
Chloride	6
Fluoride	0
Color	0.05
Turbidity	0.25
pH	7.5

9. DORCHESTER POLICE VILLAGE - Wells

Hardness	310 ppm
Alkalinity	212
Iron (Fe)	0.05
Chloride	21
Fluoride	0
Color	5
Turbidity	1.8
pH	7.5

PRIVATELY OPERATED PUBLIC SYSTEMS

A number of privately owned and operated water works systems are in use in the Townships. They are relatively small in quantity produced. Some information on these may be found in the well-drilling records.

GROUND WATER ELEVATIONS

Static water levels are recorded for each well in company with other data. This indicates the vertical distance between the ground surface at the well and the water level in the well. The common base for comparison of these water elevations is the mean sea level (MSL).

To convert the water levels to the MSL base, deduct the static level from the level of the ground surface. The result makes it convenient to compare water elevations and to note the available head for drainage above sea level. Since the lakes and other bodies of surface water are usually shown with the MSL figures, this provides a convenient comparison.

OBSERVATION WELLS

A number of means are in use to measure the water levels in aquifers. Systems operated by municipalities generally include in their records these elevations. This is valuable information for use throughout the province. Well drilling records are also filed with the Province at the time of construction. This is, of course, a single operation.

Observation wells are further facilities for obtaining water information continuously or as often as desired. The Province records the data and regularly publishes the figures.

In Middlesex County, the information on observation wells is listed herewith

POLLUTION STATUS OF GROUND WATER

At present there does not appear to be any serious problem in Middlesex of pollution at the surface finding its way into the deep aquifers. For shallow aquifers the danger is correspondingly greater.

It is important to dispose of all surface wastes from the many operations so that the ground water will be protected and its quality preserved. This is conservation at its best.

The chemical or mineral content of ground water is generally higher than that for surface waters. This may be regarded as a natural phenomenon due to the seepage of water through the ground, and picking up these substances. Such chemicals are viewed at present with greater apprehension, especially for long term consumption.

DEEP WELL DISPOSAL

Where highly objectionable or concentrated wastes are produced, recourse has been made to pumping these, under pressure, into deep formations. In doing so, it is hoped that the wastes will

not reenter the fresh water aquifers. Reference to this is made in the report. Obviously great care is needed in this practice and frequent inspections are necessary.

QUANTITY OF WATER ABSTRACTED

Permission to abstract water from either surface supplies or ground water is required in Ontario.

In Middlesex, the quantity of water abstracted for municipal public systems is relatively small since London changed to the lake supply at Grand Bend.

Ground water is used municipally by Strathroy, Glencoe, Lucan, Wardsville, Lambeth and Dorchester.

The estimated annual consumption in these places is 475 mg.

SUMMARY AND CONCLUSIONS

GROUND WATER, COUNTY OF MIDDLESEX

The following observations are based on information secured from several sources, with related interpretations. Ground water in Middlesex is an important resource and can mean much to the future welfare of the County.

(1) The records of wells, water resources, water quality and purification, combined with adequacy of supplies for the County's needs have been examined.

(2) Particular attention has been given to municipal or public, industrial and private supplies.

(3) Water supply must be considered as one of the great natural resources of the County. It will continue to be so .

(4) The focal point of the County in water needs is the City of London and its environs. There has now been extensive experience in this area with ground water, lake water, and industrial water. The development of a project for bringing high quality water from Lake Huron assures an adequate quantity for the future.

(5) The municipal or public water works systems serve a total population of 261,110. The municipalities of Strathroy, Glencoe, Lucan, Wardsville, Lambeth and Dorchester use ground water for their public supplies.

(6) The annual withdrawal of ground water for these public systems was not relatively great. When to this is added the withdrawal from wells for private use, it will be seen that a reservoir must be present to balance

the incoming and outgoing waters. In this County there is general stability in the underground reservoirs.

(7) Rural areas rely chiefly on well water, now developed by drilling. With proper technique, no great difficulty has been encountered. The chemical content, however, is mostly high as the well deepens. Some of this is annoying, but not yet shown to be dangerous to health. There is no undue difficulty as yet in controlling bacterial pollution. Chlorination is widely used as an added safeguard.

(8) The fluoride content of many wells is in the range of acceptability for human consumption. This must be regarded as a distinct advantage.

(9) There is no evidence as yet of man-made chemical pollution of deep wells, but care will be needed continuously to protect against this danger. The geological formation in some places may be subject to openings which will permit the passage of pollutants for some distance. The degradation of some wastes may be slow.

(10) Legislation for control of the water resources of the County is largely provincial in origin. It authorizes the local agency to operate effectively. Where changes become desirable it is feasible to have this change enacted in the Legislature.

(11) Conservation measures for ground water are to be encouraged, especially where a community must rely on wells. This is a wise use of this resource.

(12) The extensive use of ground water in the County is clear from the tabulation of well drillings as prepared by the Ministry of Environment.

APPENDIX

9

COUNTY OF OXFORD

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

1 9 7 7

CONTENTS

COUNTY OF OXFORD

OXFORD COUNTY

Oxford is a historical County. It is rich in history, in agriculture, and industry. Favorably located among other counties, progress in so many ways has not been surprising. Its natural resources have served its people well. Industry has been favored, and it has proven beneficial.

The County is well organized into municipalities for administrative purposes. Woodstock, as the county centre, is the only city. It will be interesting to examine how water resources have played their part in this progress and in human well-being.

THE COUNTY

The municipal organizational scheme provides for one city, 2 towns, 4 villages, and 11 townships. The total population (1975 statistics) was 83,303, of which 26,137 (31%) was in the one city of Woodstock. In towns is found a population of 17,079 (20.5%), and townships with a total population of 40,267 (48.3%). Thus the rural population exceeds that in the city, while the total urban population is only 43,216 of 52% of the total in the County. The County can generally be regarded as rural.

The total assessment for 1973 was $152,372,000, and acreage 485,333.

Oxford County was settled at an early date. Transportation facilities by roads aided the development. The settlement began last century. Being an inland area, it was not aided greatly by water transport. The branch of the Thames River was the major navigable stream. This same lack of a major watercourse had a marked influence on the selection of public water supplies.

The Thames River traverses part of the County, but this has not been considered suitable for domestic use. It is rather a means for use in agriculture and for carrying away wastes.

DRAINAGE OF THE LAND

Drainage facilities are adequate in providing an outlet to the Great Lakes System. The presence of a major outlet combined with tributaries and land drainage schemes enables effective use of the land for agriculture. In following the travel of rainfall to an outlet from the Township, seepage of water into the underground must take place. It replenishes the underground reservoirs, but what amount of the total precipitation on the area of the County enters the ground water can be estimated only.

GEOLOGY OF THE AREA

The geology of the County is somewhat like that in Southwestern Ontario. The quality of the water is affected in a similar manner. The logs of the wells vary over the County and the static level of the water in the wells varies from shallow to appreciable depth.

INDUSTRIAL NEEDS

Since the urban population is not large, the industrial demands for water can be expected to be reasonable. Industry can obtain water either from the municipal public supplies or from deep wells.

Woodstock has been able to secure water for all purposes from wells and springs. It has not been considered necessary to pipe water long distances to supply local needs. The same applies to other communities. What may be required in the future will obviously depend on industrial developments and population expansion.

RURAL WATER SUPPLIES

The high percentage population in the rural parts of the County

puts emphasis on the availability and use of ground water. The agricultural areas have, in general, been able to obtain water from wells. Here, like in similar locations, the well supplies are subject to fluctuations. Dry periods create difficulties, and it is difficult to avoid this.

Some of the more significant wells drilled in the County are shown in the following tabulation of this report.

WELL DRILLING RECORDS

The following data show some of the characteristics of the larger rural wells. Most are used in agriculture, but some serve other purposes, such as industry, small communities, recreation, etc. The chemical analyses of these waters are in general not available unless the water is used for community needs or a request has been made for the analyses. The composition of the water may usually be similar to others in the vicinity which have been examined.

BLANDFORD TOWNSHIP - BEACHVILLE VILLAGE

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
F. Lowes			5		132	35
G. Bailik			8		130	335
A. Mushlian			6		26	300
H. Griffeon			5		13	240
Neilson's			6		29	30

BLANDFORD TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
R. Walther	7	3	6		52	20
Bayer Farms	3	8	7		32	35
Park Haven Lake	4	2	8		4	29
Eaton Yale & Townle	5	6	5		10	20
F. Peters	5	8	5		9	20
R. Franklin	6	6	4		8	20
Boekel Bros.	8	8	5		18	20
Union Gas Co.	10	3	6		Flow	30
D. M. Ritchie	11	5	5		Flow	20
T. Arnott	11	7	5		4	20
C. Roth	11	8	4		14	25
L. Peat	12	7	5		11	20
Clayton Stere	12	7	30		5	30

BLENHEIM TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
G. Matheson	1	13	30	66	3	40
Rayrock Mines	1	21	8	156	2	75
do	1	21	10	156	3	100
C. Gotwowski	3	3	30	15	10	30
J. Nagy	3	19	5	1	12	20
J. Magee	5	18	36	57	38	30
W. Macey	6	10	4	129	45	20
D. Carson	6	17	4	217	40	20
H. Boehmer Co.	7	12	7	201	40	50
D. Harmer	7	12	36	48	35	45
D.H.O.	10	4	5	247	117	30
do	10	4	5	250	72	40
L. Wettlaufer	10	24	7	68	16	20
B. Steinman	10	24	6	98	27	25
Com.Farm of Brethern	11	11	30	30		30
J. Tew	12	14	5	157	15	20
Canada Sand Paper Ltd.	12	18	8	69	7	80
do	12	18	5	69	3	20
do	12	18	5	69	4	20
School Section #2	13	17	7	195	3	50
O.W.R.C.	13	18	7	56	8	100
W. Bourne	13	18	30	40	8	20
D. Kirkhamer	14	6	5	171	15	25
Ministry of Environment	14	7		220		

DEREHAM TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
Canada Dairies	1	1	4	158	36	202
F. Harrison	1	1	6	251	50	20
do	1	1	6	251	50	20
C. Antonissen	1	14	5	277	7	20
A. Bennington	2	1	7	208	25	20
J. Allison	2	22	5	248	60	20
M. Long	3	11	5	184	63	20
R. Mitchell	3	16	5	200	10	25
Mt. Elgin Village	4	11	8	155	32	32
R. Smith	4	21	5	221	55	20
H. Allison	4	22	5	305	55	20
V. Simmons	5	21	5	165	20	20
W. A. Armstrong	5	22	30	25	18	20
H. Dejong	6	21	6	63	47	20
do	6	21	6	63	47	20
P.U.C.Tillsonburg	10	6	6	60	8	70
do	10	6	26	74	13	300
do	10	8		123	59	200
do	10	8	2	108	61	
do	10	8	1	203	62	
Brownsville Water	10	22	8	108	20	30
P.U.C.	11	7	2	121	10	22
Ramore Trailer Park	11	7	7	93	16	20

Dereham Township - continued

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
P. Germuska	12	27	5	173	16	30 Sulphur
H. Dewey	8	6	5	105	8	25
Hi Skie	8	12	6	147	44	20
N. Coblentz	8	25	4	125	55	20
G. Chafe	9	8	5	142	60	20
G. Maxwell	9	26	36	41	8	40
A. Noad	10	1	7	250	60	40
A. McCall	10	4	5	185	95	20
H. Beatty	10	10	5	168	47	25
J. Gill	10	20	5	125	20	
Uniondale School	10	27	5	176	88	20
Uniondale Cheese	10	31	6	180	49	35
A. Hutton	10	34	5	125	55	30
V. Cividino	11	6	5	100	17	20
S. Weir	11	7	5	155	40	20
R. Gregory	11	21	36	32		90
W. Hutton	11	31	5	240	40	70
H. Thornton	12	11	5	99	10	20
H. Roden	12	16	5	130	10	20
J. Van Ostaegen	13	14	5	161	Flow	60
K. A. McWilliam	14	8	5	155	50	100

EAST OXFORD TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
G. Imrick	1	13	7	112	6	30
T. Durham	2	6	36	46	20	45
V. Canfield	2	13	7	230	42	30
Woodstock P.U.C.	2	15	10	64	Flow	20
do	2	16	10			
do	3	16	2	87	1	40
E. Alyea	3	17	5	140	55	20
Woodstock P.U.C.	3	17	2	93	Flow	
Sand & Gravel Ltd.	3	18	7	55	5	20
N. Schell	3	18	4	144	16	20
do	3	18	5	142	11	25
J. Payne	3	19	5	168	25	20
S. Van Dorps	5	17	5	82	26	20
D. Wood	5	17	5	68	6	75
M. Veestra	5	18	4	118	Flow	20
J. Pool	5	18	5	119	Flow	20
G. Koning	5	18	5	136	23	60
G. Kitchen	5	18	5	80	30	20
C. Denton	6	6	5	63	Flow	20
G. Row	6	19	4	147	Flow	25
H. Malcolm	7	2	36	22		45
D. Rush	8	7	4	68		20
C. Taylor	8	18	5	218	33	50

EAST ZORRA TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM	
W. Magill	9	2	4	138	26	25	
A. Hart	9	5	5	140	32	20	
V. Virly	9	7	6	121	36	20	
C. Vanderspek	9	17	4	134	Flow	20	
F. Balkima	9	19	4	185	22	20	
J. Murray	9	21	4	224	59	20	
H. Turner	10	6	5	91	4	20	
W. E. Stone	10	6	5	101	35	80	
Minister of Environment	10	23	6	237	44	30	
do	10	23	4	85	21		
L. Breneman	10	34	5	158	20	20	
Ontario Hospital Farm	11	4	6	100	3	40	
Woodstock P.U.C.	11	4	5				6 wells
D. Lambkin	11	6	4	76		60	
G. Watling	11	6	4	104	10	20	
C. Burlett	11	8	5	128	38	30	
Ontario Cattle Breeders	11	8	7	105	23	50	
G. Klingerberg	11	8	5	107	20	40	
W. Haggins	11	13	5	204	49	20	
T. Tyson	11	15	7	151	45	20	
E. Cross	11	15	5	158	67	20	
A. B. Lawrason	11	15	7	149	66	20	
V. King	11	15	7	144	58	40	
A. Packer	11	16	5	99	32	20	
F. Currah	11	19	5	193	41	30	
G. Pletsch	11	30	6	142	38	25	
O.W.R.C.	12	3	8	85	Flow	40	
C. Birtch	12	5	7	90	44	45	
V. J. Kaufman	12	6	6	130	22	20	
Minister of Environment	12	6	6	81			
R. Symons	12	7	7	103	18	45	
R. Corbett	12	7	5	110	19	20	
Oxford Golf Club	12	14	7	68	27	20	
G. McPherson	12	15	7	85	22	20	
J. E. King	12	20	7	175		305	
D.H.O.	12	22	6	171	26	25	
C. Clark	12	23	5	192	29	20	
D. Wiffen	12	26	5	94	Flow	30	
H. Schultz	12	31	6	121	20	20	
U.T. Con.Auth.	13	4	7	58	15	35	
J. Van Lieron	13	17	5	65	7	40	
L. Clark	13	27	5	117	Flow	25	
E. Leis	13	28	5	143	Flow	20	
M. Schmidt	13	30	5	120		20	
M. Piester	14	24	6	162	Flow	390	
E. Yantzi	14	29	5	140	16	20	
S. Erb	14	31	4	136	8	20	
D. Kaufman	15	23	7	176		30	
A. Yantzi	15	36	30	42	13	50	

East Zorra Township - continued

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
F. Smith	16	16	5	130	Flow	40
M. Witzel	16	19	5	121	13	20
H. Carter	17	9	4	55	26	20
M. M. MacDonald	17	9	7	45	19	24
C. Zandee	17	9	5	32	9	20
Homesites Co.	17	10	7	69	32	35
Innerkip Homesites	17	10	6	70	31	50
F. Lock	17	10	5	50	25	20
B. McIntyre	17	10	4	53	16	20
C. Staddan	17	10	5	51	19	20
E. Baker	18	11	4	48	26	20

EMBRO VILLAGE

Embro Village			8	200	55	70
do			8	195	55	70

INGERSOLL TOWN

Ingersoll Machine Co.			8	128	36	160
Upper Thames Concret			5	93	20	25
S. Clark			8	150	80	150
Oxford Dairy			6	84	16	50
P.U.C.			12	450	88	300 Sulphur
do			2	83	12	30
G. Wallace			5	42	31	115
P.U.C.			2	83	12	30

NORTH NORWICH TOWNSHIP

G. Wallace			5	42	31	115
C. C. Van Rosenswasy	1	12	5	110	10	20
Clear Creek Farms	1	13	5	28	9	20
J. Zelich	1	22	5	35	10	20
R. Henry	1	22	6	35	9	25
B. Veld	1	24	5	222	40	40
P. Krygsman	2	11	5	103	5	20
A. Carroll	5	4	2	24	17	83 + others
E. Couckuyt	6	4	2	30	6	33
R. Decooman	6	4	2	36	8	560 + others
J. Pathy	6	7	2	25	14	60
E. Cowan	6	12	5	97	9	24

NORTH OXFORD TOWNSHIP

J. Matika	1	4	5	140	71	60
H. Beatty	1	6	5	93	15	25

SUMMARY WELL DRILLING RECORDS

Total Wells drilled - 3,759

Wells Ending in:		
	Overburden	1,761
	Bed rock	1,994
Kind of Water:		
	Fresh	3,365
	Salt	6
	Sulphur	160
	Mineral	52
	Dry Hole	33
Water use:		
	Domestic or stock	3,165
	Irrigation	81
	Industrial	80
	Commercial	72
	Municipal	30
	Public Supply	106
	Cooling	6
	Not used	118
	Test Hole	179
	Abandoned	66

WATER LEGISLATION

Most legislation pertaining to water is at the provincial level. In this plan, the Provincial Legislature passes laws which give authority to municipal bodies. Certain restrictions are included.

Also contained in the provincial statutes are acts which provided for the creation of the Ontario Water Resources Commission, entirely a provincial body; now administered by the Ministry of Environment; also The Conservation Authorities Act, the construction of dams, and the control of water abstractions, both surface and underground.

Through all this legislation, effective administration of the water resources can be obtained. The Acts are brought up-to-date periodically as the need arises.

CONSERVATION AUTHORITIES

Special note should be made of the creation and activities of the Conservation Authorities. The objective of these is the wise management of the renewable resources of the watershed. This includes water, soil, forests, and wildlife resources.

Ground water is an important resource in this program. When floods are retarded, the flow becomes more equalized and the water has better opportunity for recharging the ground reservoirs. It is obvious that human control measures must be adopted to secure the best use of water as it falls on the earth and travels to its destination.

In the County of Oxford, conservation measures were initiated at an early date in this program and have continued to function successfully. The entire County has the advantage of being served under a Conservation Authority.

WELL WATER USE

Information has been collected on water use, particularly ground water. These data are tabulated herewith and interpretation of the material is made.

Records compiled by the Ontario Water Resources Commission (now a branch of the Ministry of Environment) are listed herewith:

PUBLIC WATER WORKS SYSTEMS

The following municipal or public water works systems are in operation:

Municipality	Date Constructed	Population	Water Sources
Woodstock	1880	26,137	Wells & Springs
Ingersoll	1891	8,105	Wells
Tillsonburg	1895	8,974	Wells
East Zorra - Tavistock	1911	7,081	Wells
Norwich Township:			
(a) Springford Hamlet			Wells
(b) Otterville			Wells
(c) Norwich	1906 & 1914		Wells

Public Water Works Systems - continued

Municipality	Date Constructed	Population	Water Sources
Southwest Oxford Twp.			
(a) Brownsville			Wells
(b) Mt. Elgin			Wells
(c) Beachville-Loueville			Wells
Zorra Township			Wells
(a) Embro			Wells
(b) Thamesford			Wells

All the public systems in this County use ground water. The population figures for parts of townships are not readily available.

INFORMATION ON WELLS - (water sources)

The following information on deep wells and other water sources is made available from the local water works systems, and the publications of the "Ministry of Environment - Ground Water in Ontario".

The water supplies for the public systems in Oxford County are:

(a) WOODSTOCK CITY area 6,035.2 acres - Population 26,137

The water supply from underground.
Well No. 1 - depth 98 feet; rated 1,400 gpm
Well No. 2 - depth 68 feet; rated 1,400 gpm
Well No. 3 - depth 56 feet
Well No. 5 - depth 100 feet
Well No. 6 - depth 110 feet; 6 inch diameter: rated 700 gpm
Well No. 7 - depth 115 feet; rated 600 gpm
(Sutherland Park) - aerated and filtered for iron and sulphur removal.
Well No. 8 - depth 48 feet, 12 inch diameter: rated 400 gpm

Raw water storage - ground level - 400,000 gallons
Total storage 4,000,000 gallons - chlorinated
Total consumption 1973 - 1,553,940,000 gallons

Analyese - 1972
Sample numbers:
1. Sweaborg wells
2. Raw water No. 7 well
3. Treated water after filter backwash
4. Sample at a private residence

Information on Wells - continued

Woodstock City - continued

Sample	pH	Alk.	Mg	Ca	Zinc	SO_4	F	Phos.	Fe
1	7.7	254	24	84	0.14	31	0.2	.005	0.10
2	7.7	255	42	104	< 0.01	188	0.9	.011	0.55
3	8.6	254	46	99	0.02	194	0.9	0.009	0.20
4	7.9	255	41	96	< 0.01	176	0.8	0.009	0.10

Also in 1973:

Well No.	Hardness	Alkalinity	Iron (Fe)	Chloride	pH	Fluoride	Color Apparent	Formazin Turbidity
1 raw	336	260	< 0.05	16	8.1	< .5	0.20	0.20
2 raw	324	259	< 0.05	8	8.1	< .5	0.10	0.10
3 raw	332	262	< 0.05	17	8.1	< .5	0.10	0.10
4 raw	288	242	< 0.05	9	7.8	< .5	0.10	0.10
5 raw	324	259	< 0.05	11	8.2	< .5	0.10	0.10
6 treated	312	250	0.10	14	8.0	< .5	0.10	0.10
7 raw	336	256	0.35	25	7.8	1.1	10	8.0
8 well in West Oxford Township								

These analyses represent hard waters.

(b) INGERSOLL TOWN

Source - 6 deep wells. All carry H_2S

Wells located at 4 pumphouses.

No. 1 - at West Oxford
No. 2 - at Merritt Street
No. 3 - at Cemetery Lane
No. 4 - at Harris Street

No. 1 Well - in rock 12 inch diameter, 380 feet deep; rated 600 gpm - splashes into concrete reservoir to reduce H_2S - reservoir 562,500 gallons - chlorinated

No. 2 Pumphouse - 3 deep wells, 12 inch diameter; 365 feet 460 feet, and 450 feet depths in rock, with a third put into service later
Well No. 1 - 325 gpm; No. 2 well 430 gpm.
Forced draft aeration - 750,000 gallon concrete reservoir - by gravity to pumps

No. 3 Pumphouse - (Cemetery Lane)
Well - 500 gpm; 12 inch diameter; 441 feet deep to a 35,000 gallon reservoir.
Aerated and chlorinated

No. 4 Pumphouse - well - 500 gpm; aerated and stored in 35,000 gallon ground reservoir - chlorinated
Elevated tank 0.625 mg.

Information on Wells - continued

Ingersoll Town - continued

Analyses - January 1974

Sample: No. 1 - Canterbury Pumphouse
No. 2 - Merritt Street Pumphouse
No. 3 - West Oxford Pumphouse
No. 4 - Cemetery Lane Pumphouse

Sample	Hardness	Alkalinity	Iron (Fe)	pH	Fluoride	Chloride
1	308	223	0.4	7.7	1.4	15
2	290	233	< .05	8.1	1.6	18
3	344	217	< .05	7.9	1.2	36
4	412	257	< .05	7.7	0.3	36

These waters are highly mineralized with high degrees of hardness, but with fluoride in the desirable range except for No. 4.

(c) TILLSONBURG TOWN

Source - 4 deep wells. No. 1 and No. 2 on Townline Road; No. 4 and No. 5 on North Street. A fifth well, No. 3 is available but not used because of H_2S.

No. 1 Well - depth 77 feet; 6 inch diameter; static level 58 feet
No. 2 Well - depth 82 feet; 6 inch diameter; static level 56 feet
No. 3 Well - depth 60 feet; 6 inch diameter
No. 4 Well - depth 75 feet; 6 inch diameter, static level 28 feet
No. 5 Well - depth 77 feet; 6 inch diameter, static level 36 feet

Chlorinated - Elevated tank.

Analyses - January 23, 1974

Sample	Hardness	Alkalinity	Iron (Fe)	Chloride	pH	Fluoride	Color Apparent	Turbidity Units
1	246	158	0.35	6	7.5	0	< 5	1.2
2	238	161	0.45	26	7.6	0	< 5	1.5
3	256	159	0.20	16	7.6	0	< 5	0.45
4	266	218	< .05	14	7.7	0	< 5	0.10
5	98	163	< .05	5	8.0	1.8	< 5	0.10
6	96	163	< .05	5	8.1	2.0	< 5	0.15

PRIVATELY OPERATED PUBLIC WATER WORKS SYSTEMS

1. BLANDFORD - BLENHEIM (former Blandford Township)

1. Forest Estate Park Water Works system

2 sets of 2 sand point wells. 52 services - depths 27-1/2 feet

Privately Operated Public Water Works Systems

Blandford- Blenheim- continued

and 60 feet. Capacities - 5 and 60 gpm;
Well pit No. 3 - 2 sand point wells; depth 60 feet;
rated 60 gpm.

Analyses

Well	Hardness	Alkalinity	Iron (Fe)	Chloride	pH	Nitrate	Phos.	Total Solids	Diss. Solids
1	214	172	1.6	7.0	7.8	2.4	.013	350	325
2	190	132	0.10	10 .	8.0	2.7			
3	196	166	0.10	3	7.9	0.30			

2. W. Baird Private Water Works System

No. 1 system - well 78 feet - 18 services, raw - 7 inch dia.
No. 2 system - well 98 feet - 33 services, raw - 6 inch dia.
and one 7 inch diameter; 96 feet deep.

Analyses

Well	Hardness	Alkalinity	Iron (Fe)	Chloride	pH	Fluoride	Color	Turb.	SO_4
1	378	296	0.35	21.5	7.6	0	< 5	1.1	90
2	304	240	0.70	13.0	7.8	0.1	20	8.7	58

2. EAST ZORRA TOWNSHIP - TAVISTOCK

1. J. E. King Private Water Works System

Well - 175 feet deep and 7 inch diameter; 24 services.
Chlorinated

Analysis - September 10,1975

Hardness	298	ppm
Alkalinity	243	
Iron (Fe)	1.0	
pH	7.56	
Fluoride	1.4	
Color	< 5	
Turbidity	4.4	

5 - 200 gallon tanks.

2. E. Carter, Innerkip Homesites at Innerkip
formerly Township of East Zorra
2 drilled wells - raw - 38 services

No. 1 Well - 69 feet deep 7 inch diameter; 35 gpm rated
No. 2 Well - 50 feet deep 6 inch diameter; 50 gpm rated

Privately Operated Public Water Works Systems - continued

E. Carter, Innerkip Homesites - continued

Analyses - March 18, 1975

	Residence	
Hardness	1,100	ppm
Alkalinity	222	
Iron (Fe)	0.2	
Chloride	9.0	
pH	7.2	
Fluoride	1.2	
SO_4	800	

3. TAVISTOCK (formerly Village of Tavistock)

1. Tavistock Public Water Works System

2 drilled wells - 605 services

Main Well - 33 feet deep, 8 inch diameter to an open reservoir of 150,000 gallons, then by gravity to pump-house - chlorinated

Park Well - 64 feet deep, 8 inch diameter to power house, then to system. Pumpage, average 161,078 gallons per day.

Analyses

	Well No. 1	Well No. 2	
Hardness	320	336	ppm
Alkalinity	277	276	
Iron (Fe)	0.01	0.01	
Chloride	23.5	23.5	
pH	7.8		
Fluoride	$<$ 0.1	$<$ 0.1	
Nitrate	3.3	3.3	

4. EAST ZORRA - TAVISTOCK (former E. Zorra)

1. Chambers Private Water Works System

Well - 230 feet deep, 6 inch diameter, chlorinated overhead steel tank - 4,000 gallons

Analyses - September 10, 1975

Hardness	254	ppm
Alkalinity	238	
Iron (Fe)	0.18	
Chloride	2.5	
pH	7.6	
Fluoride	1.1	
Color	$<$ 5	
Turbidity	4.4	
SO_4	25.5	
Nitrate	0.08	

Privately Operated Public Water Works Systems - continued

East Zorra - Tavistock - continued

2. Borden Water Works System (E. Zorra Township)

Well - 230 feet deep, 6 inch diameter; 14 consumers
Elevated tank, capacity 4000 gallons

Analyses - April 6, 1968

Hardness	376	ppm
Alkalinity	232	
Iron (Fe)	0.3	
Chloride	3	
pH	7.6	
Fluoride	1.1	

3. Norwich Village

No. 1 Well - 128 feet deep, 6 inch diameter
No. 2 Well - common source with No. 1 Well
No. 3 Well - (Borden Well - as standby for community

Pumpate 1973 - 52,946,766 gallons
Maximum per day - 226,920 gallons
Minimum per day - 63,860 gallons
Average per day - 145,060 gallons
Chlorinated

Analyses - January 16, 1974

	Well No. 2 (raw)	Well No. 1 (treated with sodium silicate)	
Hardness	206	216	ppm
Alkalinity	206	210	
Iron (Fe)	0.50	0.55	
Chloride	5	6.0	
pH	7.5	7.7	
Fluoride	0.9	0.9	
Color	15	5	
Turbidity	6.3	4.9	

5. TOWNSHIP OF NORWICH (formerly Twp. of East Oxford)

1. Alfred Payne Private Water Works

Well - 168 feet deep, 5 inch diameter; 8 services
Static level 25 feet - 200 gallon pressure tank.

Analysis - January 8, 1975

Hardness	536	ppm
Alkalinity	298	
Iron (Fe)	0.05	
Chloride	125	
Fluoride	0.3	

Township of Norwich - continued

Alfred Payne Private Water Works - continued

Analysis - continued

Color	< 5
Turbidity	0.55
SO_4	37.5

6. TOWNSHIP OF SOUTH NORWICH (former) Police Village of Otterville.

Public system
2 sets of 4 sand points - raw - 280 services
40,000 U.S. gallon stand pipe
1973 pumpage - Total 12,534,282 gallons
Average per day - 34,340 gallons
Maximum per day - 98,600 gallons
Minimum per day - 21,000 gallons

No. 1 Pumphouse (standby only)
2 sets of 4 sand point wells interconnected; 60 gpm
No. 2 Pumphouse - well 31 feet deep, 8 inch diameter
Elevated tank - 40,000 U.S. gallons

Analyses

Pumphouse	Hardness	Alkalinity	Iron (Fe)	Chloride	pH	Fluoride	Turb-idity	Nitrate
1	312	24	0.10	17	7.7	0	0.55	8.2
2	280	184	< 0.05	12.5	7.8	0.1	0.30	1.8

7. TOWNSHIP OF NORWICH

Springford Cooperative Water Works System

3 drilled wells in separate pumphouses - 85 services

Well (West) - 84 feet deep, 6 inch diameter; rated 15 gpm. static level 45, pressure tank 325 gallons.
Well (East) - 79 feet deep, 6 inch diameter, static level 45 feet; pressure tank 325 gallons.
Well (North)- 86 feet deep, 8 inch diameter, 40 gpm rated, static level 34 feet.

Analyses - September 25, 1975

Well	Hardness	Alkalinity	Iron (Fe)	Chloride	pH	Color	Turb-idity	SO_4	Fl
1	78	157	0.10	1.5	8.2	< 5	0.45	18.5	1.6
3	82	161	0.03	1.0	8.3	< 5	0.35	17.5	1.5
2	Dry at times								

Privately Operated Public Water Works Systems - continued

8. VILLAGE OF BEACHVILLE(former) Municipal Water System

One drilled well, and 5 shallow infiltration wells for emergency. 1,000 gallon pressure tank. Chlorination. Infiltration wells - 6 feet diameter, depth 14 feet. Drilled well (1969) - 4.5 inch diameter, depth 109 feet. A deep bored well (1967) abandoned.
40 services

Analyses - (raw)

Well	Hardness	Alkalinity	Iron (Fe)	Chloride	pH	Color	Turbidity	SO_4	Nitrate	Fl.
1	238	246	9.8	21	7.4	15	32	50	0.65	0.7
2	270	240	2.5	57.5	7.4	5	5.6	60	3.5	0.5

9. TOWNSHIP OF DEREHAM

1. Bowmanville Cooperative Water Works System

2 drilled wells - 96 homes and 27 other units.
Average flow per day - 14,343 gallons
Maximum flow per day - 18,914 gallons
Minimum flow per day - 12,157 gallons

Old (South) Pumphouse - well 117 feet deep (1954)
8 inch diameter - 600 gallons pressure tank. Static level 27 feet
New (North) Pumphouse - 118 feet deep (1962)
8 inch diameter - 215 gallon pressure tank, static level 20 feet, and 123 services

Analyses - September 4, 1974

Well	Hardness	Alkalinity	Iron (Fe)	Chloride	pH	Fluoride	Turbidity	Nitrate
South	100	135	0.05	4	8.5	1.6	0.6	0.02
North	102	125	0.10	4	8.4	1.6	0.5	0.01

2. Mount Elgin Water Works (Former Dereham Twp.)

2 wells in a common aquifer
Flow (1973) - total 52,946,766 gallons
Maximum per day 226,920 gallons
Minimum per day 63,860 gallons
Average per day 145,060 gallons

No. 1 Well - 128 feet deep, 6 inch diameter
No. 2 Well - 128 feet deep, 6 inch diameter

Privately Operated Public Water Works Systems - continued

Mount Elgin Water Works - continued

Analyses - November 1974

Well	Hardness	Alkalinity	Iron (Fe)	Chloride	pH	Fluoride	Color	Turbidity	SO_4
New	190	211	0.64	3.5	7.7	1.5	5	7.3	23
Old	172	184	0.04	1.5	8.0	1.83	< 5	0.5	16

3. R. Shaftoe Water Works System - Verschoyle (former Dereham Twp.)

Well - 108 feet deep, 6 inch diameter - 6 services
No treatment.

Analyses - September 19, 1975

Hardness	74 ppm
Alkalinity	135
Iron (Fe)	0.13
Chloride	1.5
pH	8.2
Fluoride	1.6
Nitrate	0.15

10. SOUTH WEST OXFORD (new) TOWNSHIP

1. M. Allison Private Water Works - Verschoyle

Dug well - 35 feet deep - 9 services. No treatment

Analyses - November 7, 1974

Hardness	160 ppm
Alkalinity	166
Iron (Fe)	< 0.05
Chloride	25
pH	7.8

2. Ramore Trailer Park Water Works System

2 drilled wells - raw - 40 services

Old well - 70 feet deep, 5 inch diameter; 8 gpm rated
New well - 93 feet deep, 7 inch diameter; 28 gpm rated

2 pressure tanks of 120 gallons each

Privately Operated Public Water Works Systems - continued

South West Oxford (new) Township - continued

Ramore Trailer Park Water Works System - continued

Analyses

Hardness	92	ppm
Alkalinity	151	
Iron (Fe)	< 0.05	
Chloride	2.2	
pH	8.1	
Fluoride	1.4	

3. Donland Subdivision Water Works System - Twp. Oxford West

Well - 135 feet deep to a concrete reservoir of 13,100 gallons - 56 services

New Well - 135 feet deep 5 inch diameter
Old Well - 124 feet deep 5 inch diameter

Analyses - January 8, 1974

Hardness	276	ppm
Alkalinity	255	
Iron (Fe)	0.55	
Chloride	4	
pH	7.4	
Fluoride	1.1	
Color	10	
Turbidity	5.8	

4. J. Dzus Private Water Works System - (Oxford West Twp.) (former)

Well - 152 feet deep, 8 inch diameter, 16 services
2 pressure tanks of 120 gallons each. No treatment.
Static level 45 feet, test rate 40 gpm.

Analysis - October 28, 1974

Hardness	240	ppm
Alkalinity	239	
Iron (Fe)	0.6	
Chloride	5.4	
pH	7.6	
Fluoride	0.4	
Color	10	
Turbidity	5.3	

Privately Operated Public Water Works Systems - continued

Oxford West Township - continued

5. Rossland Road Subdivision - J. A. Smith

Well - 150 feet deep, 10 services. No treatment.
Static level 70 feet; 5 gpm rated.

Analysis - January 29, 1974

Hardness	208	ppm
Alkalinity	173	
Iron (Fe)	< 0.05	
Chloride	6	
pH	8.2	
Fluoride	0.6	

11. VILLAGE OF EMBRO - (former) Public Municipal System

2 drilled wells - 20 feet apart. No storage

Well No. 1 - 195 feet deep, 8 inch diameter - 1968 year
Well No. 2 - 200 feet deep, 8 inch diameter - 1968 year

193 services. Static level 55 feet; pumping level 60 feet
70 gpm rated.

Analysis - October 29, 1974

Hardness	580	ppm
Alkalinity	216	
Iron (Fe)	0.50	
Chloride	1.5	
pH	7.7	
Fluoride	1.3	
Color	5	
Turbidity	43	
SO_4	370	

12. NISSOURI TOWNSHIP EAST (Former)

1. Menzer Private Water Works System

Deep well (1959) - 7 services. No treatment. Depth 250 feet; 7 inch diameter; static level 60 feet pumping level 90 feet - 40 gpm rated; ground reservoir 24,500 gallons. Pressure tank 1000 gallons.

Analysis - October 8, 1975

Hardness	186	ppm
Alkalinity	208	
Iron (Fe)	0.27	
Chloride	1.6	
pH	8.0	
Fluoride	1.2	

Privately Operated Public Water Works Systems - continued

Menzer Private Water Works System - continued

Analysis - continued

Color	< 5
Turbidity	2.8
SO_4	5.0

2. Vining Private Water Works System

Well - 325 feet deep, 4 inch diameter - 28 services
2 - 120 gallon pressure tanks - untreated

Analysis

Hardness	212 ppm
Alkalinity	210
Iron (Fe)	0.26
Chloride	0.5
Fluoride	1.4
Color	< 5
Turbidity	6.0
SO_4	15
Nitrate	0.16

13. ZORRA TOWNSHIP (formerly Missouri East)

1. Sunova Lake Subdivision (Lakeside)

Well - 257 feet deep, 6 services. No treatment.

Analysis - June 20, 1975

Hardness	168 ppm
Alkalinity	191
Iron (Fe)	0.46
Chloride	1.0
pH	7.6
Fluoride	1.3
Nitrate	0.26

2. Thamesford Water Works

No. 1 Well - George Street - Lot 1, concession 10
No. 2 Well - McFarland - lot 22, concession 1, North Oxford Township (1956). 8 gpm. Sulphur water - 304 feet deep, 8 inch diameter. Static level 25 feet. 65 gpm rated.
No. 3 Well - Cold Springs Farm - Lot 22, concession 1, North Oxford Township (1961) 388 feet deep, 8 inch diameter, 140 gpm rated
No. 3 Well - Lot 22, concession 1, North Oxford Township (1961) - 70 gpm, 250 feet deep
No. 2 Well - Lot 21, concession 1, North Oxford Township (1966) sulphur - 135 gpm rated; 260 feet deep.

Privately Operated Public Water Works Systems - continued

Thamesford Water Works - continued

Analyses

	No. 1 Well	No. 2 Well	
Hardness	148	140	ppm
Alkalinity	182	182	
Iron (Fe)	0.45	0.20	
Chloride	0.5	0.5	
pH	8.3	8.4	
SO_4	1.0	0.5	
Fluoride	1.5		

3. J. Alderson Water Works System

Well - 110 feet deep, 6 inch diameter, rated 300 gallons per hour, static level 60 feet. Pumping level 68 feet. 9 services. No treatment.

Analysis - October 8, 1975

Hardness	264	ppm
Alkalinity	259	
Iron (Fe)	0.65	
Chloride	17.5	
pH	8.2	
Iron (Fe)	0.7	
Color	5	
Turbidity	8.8	
SO_4	27.5	
Nitrate	0.73	

4. Plattsville School

Analysis - November 15, 1974

Hardness	1800	ppm
Alkalinity	187	
Iron (Fe)	3.2	
Chloride	4.7	
pH	7.4	
SO_4	1680	

GROUND WATER ELEVATIONS

Static water levels are recorded for each well, along with other data. This shows the vertical distance between the ground surface at the well and the water level in the well when not in use. The common base for comparison of these water elevations is mean sea level (MSL).

To convert the water level to the MSL base deduct the static level from the level of the ground surface. (It is given in relation to MSL). This result makes it convenient to compare water elevations and to observe the available heads for drainage above the sea level.

OBSERVATION WELLS

Records of the water elevations in the aquifers are noted and retained in a number of ways. Municipally operated wells generally include these elevations in their records. This furnishes a substantial amount of information throughout the areas of the province. The levels are also recorded in drilling operations, but these are only single figures.

Observation wells offer another facility for obtaining this information continuously or as often as desired. The Province records the data and makes it available.

A periodic review of these levels should indicate any trend in the ground water storage. The levels tend to fluctuate up and down with the rainfall. This must be expected. There does not appear to be any long-time lowering trend for these wells in the County. This means that the amount of water withdrawn is not in excess of the input.

POLLUTION STATUS OF GROUND WATER

At this time, there is no indication of surface pollution finding its way into the deep aquifers. At the same time it is important to so dispose of all wastes at the surface from the many operations that the ground water will be protected and its quality preserved. This, is an effective way for conservation.

SUMMARY AND CONCLUSIONS

GROUND WATER, COUNTY OF OXFORD

The following observations are based on information secured from several sources, with related interpretations. The ground water resource is highly important for Oxford County.

(1) The records of wells, water resources, water quality and purification, along with adequacy of supplies for the County's needs have been examined.

(2) Attention has been given especially to municipal or public, industrial, and private water supply systems.

(3) Oxford County is fortunate in many respects in having such water resources in the underground. This will mean much to the welfare of the County in the future.

(4) The greatest need for water at any one point is Woodstock City. Over a period of years these water resources have been developed. There is no indication at this time for the need to transport water from a distant source. Forecasts for long-term water needs are desirable on a continuing basis.

(5) The municipal or public water works systems in the urban centres serve a total population in excess of 55,000. All use ground water for their public supplies.

(6) The annual withdrawal of ground water for these public systems was relatively small.
To this should be added the withdrawal from wells for private use. To meet these requirements a large reservoir or aquifer is required, with continuous recharging.

Summary and Conclusions - continued

(7) The rural areas rely on wells, now developed by drilling. No great difficulty appears to have been encountered in getting sufficient water. The chemical content of much of the ground water is high but not dangerous. There is no undue problem as yet in controlling bacterial pollution. Chlorination is used as an added safeguard.

(8) In a number of wells the water contains fluoride and is accordingly desirable for the protection of teeth. This mineral has been present in these waters for many years without knowledge of the consumers.

(9) There is no evidence as yet of man-made chemical pollution of deep wells, but care will be needed continuously to protect against this danger. The geological formations may be subject to crevices or lack of filtering facilities against such wastes. Under such conditions the chemical may be transported a long distance.

(10) The legislation for control of the water resources of the County is largely provincial in origin. It authorizes the local authorities to act.

(11) Conservation of ground water is essential throughout the County. This means the wise use of this renewable resource.

(12) The extensive use of ground water in the County is shown in the periodic tabulation of well drillings prepared by the Ministry of Environment.

APPENDIX

10

COUNTY OF PERTH

GROUND WATER IN SOUTHWESTERN ONTARIO

A REPLENISHABLE RESOURCE

1 9 7 7

CONTENTS

COUNTY OF PERTH

COUNTY OF PERTH

A boundary of irregular shape, equally conspicuous on the map, encloses the County of Perth. Its inland location and absence of large streams, especially in the low-flow periods, enchance the importance of ground water resources. The political organization of the County for administrative purposes contains one city, three towns, one village, and eleven townships. One police village operates in Hibbert Township.

THE COUNTY

Industrial and commercial activities play an important role. Agriculture flourishes on the fertile soil. There is an accompanying need for adequate and reliable water supplies. Forestry was at one time an important feature, prior to the more intense farming and industrialization. Institutions of learning, public health administration, and human welfare are given solid support. Environmental protection, especially water and air pollution, has received the attention necessary to ensure a safe and congenial centre for living.

The total population for the County (1975) was given as 64,984, of which 24,945 was in the City of Stratford. The combined populations of the three towns and one village was 13,699. The townships had a total population of 26,340 or over 40% of the total of the County. Thus the urban total of 38,644 compares with the rural of 26,340. This division of population is significant in the estimated needs for water supplies and environmental control in general.

In a total county area of 840 square miles the land acreage, is listed as 534,778. The total assessment was 155,949,845 for general purposes. The County seat is Stratford.

Where a domestic water supply is obtained from the surface, the quality must be basically good, such as found in a lake or river

of substantial flow all through the year. In Perth, the Thames River is the largest of these streams. Most of the others are variable in flow and small in size as they pass quickly out of the County.

These unusual drainage geographical factors in this County are explained in the following statement in the "History of Perth County" - by Johnston and Johnston.

"While every railway and highway route climbs to enter Perth County, the converse is true of the river systems which provide the drainage pattern for agriculture in this County. Water runs downhill, and every river that crosses the boundary of Perth is a geographical roof-top, shedding water in all directions toward three of the reservoirs of the Great Lakes system. The south half of Perth drains by way of the Thames River to Lake St. Clair. Most of the north end of Perth drains by way of the Maitland River to Lake Huron. On the east side of Perth, Mornington Township and portions of North Easthope and South Easthope drain by way of the Grand River system to Lake Erie."

None of these streams can be considered favorably for domestic and drinking purposes. The fact alone that the flows are variable and low in volume makes them unattractive for urban areas. These watercourses may be at the same time quite suitable for agricultural purposes. Some recreational facilities have been developed, especially along impoundments in the streams.

The lack of adequate surface waters places the burden on ground water resources. If the rainwater runs off too quickly the underground reservoirs will not be sufficiently replenished. Accordingly, there is a close interrelationship among all the activities of nature.

All urban centres served by public water works systems utilize wells, and the long periods of use attest to the value of these waters.

The laboratory analyses of these waters reveal high mineral contents. Hardness is common.

GEOLOGY IN COUNTY

The geological formation over Perth County concerns water storage and quality. A description is given of the geological formations in Geological Circular 13, of the Government of Ontario. This states:

"The Province of Ontario is underlain by rocks of two major geological ages; firstly, by the very ancient Precambrian rocks of the Shield area, and secondly, by the relatively young Phanerozoic rocks filling basins within or along the edges of the Shield.

The rocks of the Precambrian Shield occupy more than two-thirds of the surface area of Ontario and have had a complex history of igneous intrusion and extrusion, sedimentation, and metamorphism. Paleozoic rocks have been deposited in three major basins adjacent to Ontario.

All of southern and southwestern Ontarion, south of a line extending from Midland on Georgian Bay to Kingston on Lake Ontario, and west of the Frontenac Axis, is underlain by Paleozoic rocks. These Paleozoic formations also extend up the Bruce Peninsula and across into Manitoulin."

An examination of the map in the above publication shows that the County of Perth is mostly in the Dundee Formation - limestone. In this general area the formations are shown to be limestone and dolomite, and grey shale and sandstone. The hardness of the different groundwaters in this area attests to the presence of limestone.

Drainage of the soil affects the penetration of rainfall into

the ground water reservoir. In the Soil Survey of Perth County it was found that "over half the County suffers from unsatisfactory drainage. Drainage problems occur when water runoff is slow because of insufficient slope or when water percolation is impeded due to the impermeability of the underlying materials. The findings showed good drainage 33.8%, imperfect, 41.4%, and poor 22.9%."

"It is further stated that "During the process of formation, different layers have developed in the soil which can be observed in a vertical cross section of the soil to a depth of about three feet. This is generally referred to as the soil profile - Two distinct kinds of profile occur in the Perth County area. Each kind of profile represents what is called a Great Soil Group. Soils of the Grey-Brown Podzolic and the Dark Grey Gleisolic Great Soil Groups dominate in the County."

No reference is made in the above report to the extent precipitation seeps into the underground. Where the water is carried off rapidly in watercourses, the ground water reservoir is the loser.

Public water works systems are in operation for Stratford, St. Marys, Listowel, Mitchell, Milverton and in some other small urban centres not created into villages.

INDUSTRIAL NEEDS FOR WATER

Industrial operations are substantial. Many of these are in urban centres and are connected to the municipal mains. Some have their own wells for standby or reserve. The St. Marys Cement Co., as an example, draws large quantities of water from underground. Another industry near St. Marys and in the Township of Blanshard, The Campbell Soup Co. likewise uses a good deal of water from its own ground water area. The village of Centralia in the County of Huron obtains water from a well in Blanshard Township, from where it is pumped to an industrial development at Centralia. This system was

originally constructed in the war for an air force training centre.

Other industrial ground water supplies serve important functions. There are several wells of substantial capacity in the County. Some of these are in urban centres, while the others in rural areas generally serve industrial or commercial activities. The details of these supplies are given later.

RURAL WATER SUPPLIES

There appears to be no undue difficulty in securing water under normal conditions for farm use and scattered populations. It has been necessary to drill most wells to relatively deep levels. The major problem under these conditions occur in prolonged periods of low rainfall.

Wells in rural areas are in many instances "dug". Where rock formations are encountered the drilled wells will vary in depth. Under these circumstances water elevations in the wells will fluctuate in sympathy with the amount of precipitation, especially in prolonged drought. It is reported that generally the farm wells in Blanshard are mostly constant in volume. This is especially so for deep drilled wells. It must be expected that shallow wells, dug or drilled, of approximately 20 feet will be adversely affected in times of prolonged low precipitation. The cure is most often to deepen the well and to reach farther into the underground storage.

WELL DRILLING RECORDS

The following data show some of the characteristics of the larger drilled wells in the County. Most are for rural use. The table shows only the more significant wells to indicate conditions in general.

Well Drilling Records - continued

TOWNSHIP OF BLANSHARD

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
D. McNaughton	6	13	27	16	8	20
K. Parkinson	9	4		30	20	40
Campbell Soup Co.	14	18	12	365	196	400
D. Stevens	15	5	6	235	145	30
Cement Company	15	25	18		24	68
Public School Board	14		6	235	170	25
Blanshard Twp. School Board	14		6	250	185	30
Finnie Distributing		5		140	78	85
do		5	5	172	75	50
M. Bonus		29	3	117	40	30
DND		11	10	38	8	500
RCAF		11	16	370	124	381

DOWNIE TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
R. Reibling	1	15	4	150	15	30
Downie Ellice Twp.	1	15	7	210	19	80
Ready Boehmers	4	2	7	102	51	60
Utrca Wildwood Park	11	22	6	163	48	60
Fraser Brace Co.	11	24	12		Flow	sulphur

NORTH EASTHOPE TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
Festival City Inn	1	41	6	232	64	60
do	1	41	6	228		85
G. Roth	9	19	5	253	80	60
A. Satchell	9	31	6	190	26	30
A. Steckley	12	16	6	200	55	40

SOUTH EASTHOPE TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
J. Hood	1	32	7	59	21	30
F. Byers	1	40	4	203	76	68
R. Shore	3	40	5	189	40	30
R. Trachel	5	28	5	225	210	65
Tavistock Poultry	6	24	5	153	Flow	50

ELLICE TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
Crystal Lake Mobile	1	11	6	207	35	40
O. C. Zehr	1	18	4	77	4	40
Hillside Rest Home	1	28	6	206	62	40
Ellice Twp. School	7	20		242	48	30
W. Fink	10	21	4	170	20	60
A. Nyatten	10	34	4		15	40

Well Drilling Records - continued

ELMA TOWNSHIP

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
Campbell Soup Co.	1	13	12	325	29	600
do	1	31	10	315	18	560
Elma P.U.C.	3	5	16	87	12	450
do	3	5	16	86	8	500
O. Smith	8	16	5	156	7	40
Elma Central School	9	16	6	150	12	40
N. Hopper	2	26	6	170	70	45

FULLARTON TOWNSHIP

R. Martyn		35	36	15	3	60

HIBBERT TOWNSHIP

Dublin Creamery	1	15	6	135	35	20

LOGAN TOWNSHIP

W. Hill	4	17	6	147	20	60
Stovel and Hill	5	11	5	124	36	60
W. Hill	6	6	8	318	19	300
H. Hing	10	18	4	105	5	80

MORNINGTON TOWNSHIP

J. Raycraft	1	6	7	145	43	30
A. Albrecht	1	11	7	231	59	40
D. Jantzi	4	9	7	115	15	30
Millbank Cheese Co.	6	16	8	137	16	70
do	6	16	6	200	15	48
Bethel Holdings	6	16	7	220	18	47
School Section #1	8	7	6	222	37	55

WALLACE TOWNSHIP

H. Krotz	2	25	6	232	47	50
Wallace School Area	5	24	5	204	33	50
Malar Farms	5	48	5	170	32	35
S. McCutcheon	7	24	7	188	17	42
Hospital	7	25	7	224	32	205
do	7	26	10	202	24	225

Well Drilling Records - continued

STRATFORD CITY

OWNER	CON No.	LOT No.	DIA (In.)	DEPTH (Ft.)	STATIC LEVEL	RATED GPM
Wilkinson Ice Plant			5	140	40	
P. U. C.			12	200	49	143
do			14	440	42	520
do			14	455	44	980
Whyte Packing Co.			10	400	57	327
P. U. C.			12	493	53	614
do			12	350	64	632
do			12	265	45	500
Stratford Hospital			6	255	55	117
P. U. C.			16	80		Dry

ST. MARYS TOWN

Cement Co.			12	250	39	840
Hooper Bros. Dairy			7	108	70	75
P. U. C.			15	150	30	800

LISTOWEL TOWN

Spin Rite Yarn And Dyers			6	255	31	40
do			6	262	17	50
Park Board			5	350	26	40

MILVERTON VILLAGE

Village			10	151	38	121
do			10	159	46	165
Milverton Creamery			7	292	34	45
do			10	173	31	50
Village			6	103	36	36

WATER LEGISLATION

Legislation for the administration of water resources in Perth County is much the same as in the other counties. Most of this is provincial in its origin but administered to a large extent locally. Municipal water works are operated under both provincial acts and local by-laws. No systems in Perth County are operated directly by the Ontario Water Resources Commission (now Ministry of the Environment).

Conservation Authorities have been created in nearly all

parts of southwestern Ontario. Perth County is served by the Upper Thames River Conservation Authority. Just how direct is the relationship between the programs of these agencies and ground water supplies is not easy to determine. These are discussed further later in this report.

Active measures to conserve the water resources of the County have not yet been taken, except in those programs included in the Conservation Authorities' activities. As greater demands occur this can be expected to take place.

The construction of dams on streams, and agricultural drainage measures are subject to provincial approval. The use of dams is beneficial both for making use of surface supplies and ground water.

Ponded areas have been created at a number of places as a result of the building of dams. In addition to the surface benefits, such as hydraulic power, water storage, and recreation, these dams hold back the rainfall runoff and give it an opportunity to seep into the underground reservoirs. Many of these dams were built for power purposes, especially for grist mills in the urban centres. That function has pretty well disappeared now.

Ontario's control of abstraction of water from both surface and underground sources has been in effect for some years. It tends to ensure a division of use of this resource among all who have access to it or who have need for a common source. Permits for abstraction are not required for farm use or where the amount is small. Other users require permits for withdrawal.

CONSERVATION AUTHORITIES

Under the Conservation Authorities Act in Ontario, active measures have been taken and are being carried on to attain the objectives of these Authorities. The objective of a Conservation

Authority is the wise management of the renewable natural resources of its watershed. This includes water, soil, forests, and wildlife resources.

One of the more significant activities of the Conservation Authority in this County has been to develop water resources for the most beneficial uses. Ground water is an important facet in this program. Dams have been constructed on the major streams, primarily for flood control, but also to serve other purposes. Precisely to what extent the Authority for Perth County has been responsible for augmenting the ground water is not known in measurable terms, but it may be assumed with some certainty that a good amount of the stream flow has penetrated through the soil and rock to reach the ground water reservoir. Flood control is, of course, a major factor in the construction of storage dams, and unless these are built the heavy flows run off quickly, are lost to the area and may cause serious floods.

POLLUTION POTENTIAL FOR WELLS

To what extent is there a danger of pollution of the water in these deep wells? The depths to which these have been drilled should preclude any serious danger from biological pollutants unless the water passes through rock crevices. This would not necessarily be the case with chemical substances such as hardness, iron, chlorides, nitrates, sulphur and others. Conservation programs, invariably call for the prevention of water pollution, i.e. any substance which may injure the quality of the water for normal domestic use. More data on the contents of these waters are seen in the tabulation, and on the possibility of harmful pollution. The overall section of the report also deals with this in detail.

WELL DATA

Information has been collected on water use, and ground water in particular. This material is tabulated herewith, and interpretation of the data has been made and recorded later herein.

The records compiled by the Ontario Water Resources Commission (now a branch of Ministry of Environment) are listed herewith in summary form.

PERTH COUNTY SUMMARY OF WELLS

Total	1,819	Domestic or stock use	1,596
Overburden	264	Irrigation	20
Bedrock	2,039	Industrial	29
Fresh Water	2,227	Commercial	58
Salt	1	Municipal	19
Sulphur	26	Public Supply	80
Mineral	16	Not used	13
Dry holes	11	Test holes	13
		Abandoned	19

These are the records which have been collected and published periodically by the Ontario Water Resources Commission (now the Ministry of Environment).

PUBLIC WATER WORKS SYSTEMS

Municipality	Date Constructed	Population Supplied	Water Source
Stratford	1,883	24,945	Wells
St. Marys	1,899	4,659	2 Wells
Mitchell	1,873	2,706	2 Wells
Listowel	1,903	4,994	4 Wells
Milverton	1,920	1,340	2 Wells
Downie Twp. St. Pauls			Wells
Ellice Township			
a) Brunner			Wells
b) Atwood			Wells
Wallace Township Gowanstown			Wells

Public Water Works Systems - continued

Water Consumption

A breakdown of water consumption data in municipalities in Perth County for the latest available year are used as an example.

Municipality	Total for year (Imperial gal.)	Average per day	Maximum per day	Average per cap. per day
Stratford (1974)	1,008,771,900	2,763,759	4,234,900	98
St. Marys (1974)	254,433,400	703,243	812,592	153
Mitchell (1973)	138,600,000	380,000	631,000	140
Listowel (1974)	200,000,000	602,740	N/A	N/A
Milverton (1974)	40,843,000	91,312	183,167	68
Total	1,642,648,300	4,541,054	5,861,659	459

The above figures do not include industrial supplies from the industries' own sources; in all cases here from deep wells. Further information on these is given later.

INFORMATION ON WELLS

The following information on deep wells is made available from the local systems and the publications of the Ministry of the Environment - "Ground Water in Ontario".

The water supplies for the public water works systems in Perth County are:

(a) STRATFORD CITY area 5,024 acres.

The water all comes from deep wells.

a) Cooper Street - deep well - constructed 1953, capacity when constructed and now, 700 gallons per minute.
Static water level 46 feet, depth of well 383 feet
Cost $14,000 - pumps directly into system.
Supply is chlorinated (see analyses)

b) Field Wells
No. 1 - 1915 - 300 gpm; static water level 65 ft; depth 450 feet
No. 2 - 1915 - 350 gpm; static level 62 feet; depth 450 feet
No. 3 - 1915 - 350 gpm; static level 56 feet depth 450 feet
No. 4 - 1915 - 350 gpm; static level 61 feet depth 450 feet
No. 5 - 1915 - 250 gpm; static level 57 feet depth 450 feet

Information on Wells - continued

b) Field Wells continued

No. 6 - 1952 - capacity when constructed 1,000 gpm; present operating capacity 835 gpm; static level 56 feet; depth 455 feet.

No. 7 - 1968 - original capacity 700 gpm; present operating capacity 500 gpm; static level 61 feet depth 265 feet. Pumped to ground storage, then to system.

Costs: No. 6 - $14,000; No. 7 - $30,000

Treatment - chlorination, aeration and calgon.

(c) Chestnut Street Deep Well

Constructed 1956; capacity when constructed 500 gpm; present operating capacity 200 gpm; static water level 46 feet; depth 438 feet - rock well. Pumped to ground storage, then to system.
Cost $25,000. Treatment aeration and chlorination (see analyses)

(d) Mornington Street Deep Well

Constructed 1961; capacity when constructed 600 gpm; static water level 64 feet; depth 300 feet - rock well. (see analyses)

Other Wells in Stratford

In addition to the wells in use for the city's supply, a number of others have been constructed and used for industrial and commercial activities. Some of these are:

Stratford General Hospital - Depth 255 feet, 6 inch diameter, rated 117 gpm - Rock
F. A. G. Bearings Ltd.
Whyte Packing Co. - depth 400 feet; 10 inch diameter; rated 327 gon - rock. (Now Standard Products)

No scarcity of water for the City of Stratford is likely to occur in the foreseeable future. The supplies come from rock - limestone - formations. Cost of water treatment for 1974: Chlorination $2,200, Calgon $5,800. The cost of producing ground water into the system - $443,008, or .43.9¢ per gallon in 1974. There is storage at ground surface of - 1,200,000 gallons. Rainfall over the area is 34 inches to 35 inches per annum.

(b) ST. MARYS area 2,860.8 acres - Municipal Wells

The Town of St. Marys, located over a limestone formation draws water from the below listed wells. In addition a reserve supply of major quantity is available at the local quarries.

Well No. 1 - constructed 1971 - capacity 800 gpm; static level 36 feet; depth 150 feet; seasonal fluctuation 10 feet. Chlorination, cost $165.00 per year.
Cost of construction $30,300. Cost of producing water into system .28¢ per 1,000 gallons.
Elevated storate tank - 95,000 gallons.

Well No. 2. - constructed 1930 - capacity 560 gpm.
Well No. 2 now capped. Pumps pulled and cleaned every 5 years.

There is an abundant supply of water for St. Marys.

Other wells in St. Marys

The major water user on its own supply is the St. Marys Cement Company. Total consumption, 1973 - 172,000,000; average per day 470,000 gallons.

Well No. 4 - constructed 1957 now operating normally - capacity 600 gpm; presently operating 330 gpm.

Campbell Soup Company - adjacent to St. Marys in Blanshard Township, Concession 14, Lot 18 - 12 inch diameter; depth 265 feet; capacity 400 gpm.
Hooper Bros. Dairy - 7 inch diameter; static water level 70 feet; depth 108 feet; capacity 75 gpm.

(c) MITCHELL area 1,350.4 acres - Wells for Municipal Supply

The Town of Mitchell depends on wells for the public water supply. The data on these wells are as follows:

Well No. 1 - supplies raw water to Stacey Bros. plant (see analyses)
Well No. 2 - supplies treated water to the town. Treatment by aeration and filtration

(d) LISTOWEL area 1,081.6 acres - Municipal well supply

The wells which supply water for the municipal supply are as follows:

Well No. 1 - 8 inch diameter, 365 gpm; static water level 47 feet.
Well No. 3 - 8 inch diameter, 365 gpm; static water level 49 feet.
Well No. 4 - 12 inch diameter, capacity 1000 gpm; static water level 51 feet.
Well No. 5 - 12 inch diameter, depth 304 feet - capacity 600 gpm; maximum pumping per day 850,000 gallons. static water level 49 feet.

All wells in rock
Treatment - filtration - softening installed - storage - elevated tank 165,000 gallons and one ground level tank

Other wells in Listowel

Two companies operate own wells:

Spinrite Company - depth 255 feet; 6 inch diameter; limestone rock well - capacity 40 gpm
Campbell Soup Company - formerly outside town limits - two wells:
(1) 600 gpm; depth 325 feet; 10 inch diameter - in grey limestone shale
(2) 560 gpm; depth 315 feet; 10 incy diameter - limestone well

(e) MILVERTON area 480 acres - Municipal wells

Data on the Milverton wells are:

Two wells, No. 4 and No. 5. Water consumption for 1974 40,843,000 gallons, each 10 inch diameter, each rock wells.

Well No. 4 - constructed 1962, depth 159 feet; 165 gpm capacity, static water level 46 feet.
Well No. 5 - constructed 1965, depth 151 feet, 121 gpm capacity, static water level 38 feet. Treatment of water by sodium silicate for iron control. (see analyses)

In addition to the foregoing the Milverton Creamery has a well 10 inch diameter, capacity 50 gpm, depth 173 feet, constructed 1945. This is not now in use.

INDUSTRIAL WELL SUPPLIES

Perth County has a number of industries with high water consumption. These are either entirely separate from any municipal or public system or they are used to supplement or stand in reserve. Some of these have been noted previously.

The industrial unit at Centralia in the County of Huron draws water from lot 11 in the Township of Blanshard. This was formerly an RCAF station. Two wells were drilled in 1951 and 1952

by the Department of National Defence and RCAF. One is shallow, at 38 feet and has a rated capacity of 500 gpm; diameter 10 inches. The other is 16 inch diameter, and 370 feet deep. The capacity is rated at 381 gpm.

Similarly, the Ontario Government constructed two wells for an Ontario Hospital in Wallace Township in 1959 and 1962, at depths of 225 feet, and capacities of 205 gpm and 225 gpm.

Other wells may be found in the list of major wells in rural areas.

The following are listed as of substantial significance:

PRIVATELY OPERATED WATER WORKS

Small water works systems have come into being. They generally supply a limited number of households. Some are mere extensions of a system built by one party for his own premises.

The following are on record:

MORNINGTON TOWNSHIP

Amos Albrecht

Concession 1, lot 11, 7 inch diameter depth 250 feet, static level 50 feet, rated 30 gpm, supplying 9 households.

Hudson Private Water Works

Concession 1, lot 9, depth 180 feet - 10 services

Hergott Private Water Works

10 services

The analyses of these waters are:

	Albrecht	Hudson	Hergott	
Hardness	572	158	384	ppm
Alkalinity	162	168	225	
Iron (Fe)	2.0	0.15	0.45	
Chlorine	4	3.9	2	
pH	7.6	7.7	7.6	
Fluoride	1.2	1.6	0.5	

WATER ANALYSES

Analyses by the Ontario Ministry of the Environment on

sampled collected:

STRATFORD - sample collected January 28, 1974

Constituent	Esbeco Erie Street	Romeo Water Centre	Well #6 Mornington Street	Well #4 Chestnut Street	Well #3 Cooper Street	383 Huron Street	
Hardness as $CaCO_3$	672	520	340	272	1000	480	ppm
Total Alkalinity as $CaCO_3$	227	223	214	244	219	212	
Iron as Fe	0.30	0.55	0.35	0.75	0.20	0.70	
Chloride as Cl.	9	7	2	5	5	5	
pH at lab	7.8	7.7	7.8	8.0	7.5	7.7	
Fluoride as F	1.8	1.4	2.0	2.2	2.2	1.6	
Apparent color units	< 5	5	< 5	15	< 5	< 5	
Formazin turbidity units	2.2	3.8	2.9	5.2	1.7	4.3	
Calcium as Ca	202	152	93	75	316	139	
Magnesium as Mg	41	34	26	20	51	32	
Sodium as Na	25	21	29	27	23	25	
Potassium as K	2.5	2.5	2.2	1.9	2.4	2.2	
Silica as SiO_2	8.0	8.4	7.6	7.2	7.4	8.4	
Sulphate as SO_4	490	360	180	86	800	330	
Total Solids	920	730	490	390	1440	680	
Carbonate Alk.	0	0	0	0	0	0	
Manganese as Mn	< 0.04	< 0.04	< 0.04	0.04	0.04	0.04	

ST. MARYS - sample collected May 21, 1975

	Well No. 1	Well No. 2
Hardness as $CaCO_3$	450	430
Alkalinity as $CaCO_3$	281	220
Iron as Fe	0.60	0.05
Chloride as Cl	43.0	32.5
pH at lab	7.8	7.9
Apparent color, Hazen Units	15	< 5
Turbidity in Formazin Units	6.5	3.4
Fluoride as F	1.1	1.2
Total Phosphorus as P	0.025	0.008
Dissolved reactive Phosphorus as P	0.009	0.005
Free Ammonia	0.08	0.01
Total Kjeldahl	0.29	0.17
Nitrite	0.002	0.001
Nitrate	0.33	1.8
Bacterial analyses	clear	

No. 1 Well - West of CNR bridge over Trout Creek and North of Queen Street (formerly No. 3 well)

No. 2 Well - on Wellington Street behind the Public Utilities Commission office (formerly No. 1 well)

CONSTITUENT	Well No.1	Well No.2	Well	
Hardness	264	252	368	ppm
Alkalinity as Ca CO_3	200	197	199	
Iron (Fe)	0.60	0.05	0.20	
Chloride, Cl	8	8	11	
pH	7.6	7.5	7.6	
Fluoride, F	1.6	1.5	1.6	

No. 1 Well supplies raw water to Stacey Bros. plant
No. 2 Well supplies treated water to the town

Treatment is by aeration and filtration.

LISTOWEL - sample collected March 27, 1974

Constituent	Well No.1 (raw)	Well No.3 (raw)	Well No.4 (raw)	Well No.5 (raw)	
Hardness as Ca CO_3	224	220	208	224	ppm
Alkalinity as Ca CO_3	229	230	224	229	
Iron (Fe)	0.50	1.2	0.55	0.65	
Chloride, Cl	3	2	2	3	
pH	7.9	7.9	7.9	7.8	
Fluoride, F	0.9	0.7	1.0	1.0	
Apparent Color Units	15	15	10	15	
Turbidity Units	2.6	6.2	4.0	5.7	

Also on samples collected August 20, 1974 the following:

Nitrogen as Free ammonia	< 0.1	0.1	< 0.1
Nitrogen Total Kjeldehl	0.1	0.2	0.2
Nitrogen Nitrite	< 0.02	< 0.02	< 0.02
Nitrogen Nitrate	< 0.2	< 0.2	< 0.2
pH	7.8	7.7	7.6
Alkalinity as Ca CO_3	228	226	228
Calcium as Ca	47	44	46
Magnesium as Mg	22	23	23
Iron (Fe)	0.55	0.50	0.70
Sulphate, SO_4	9	9	9
Silica, Si O_2	7.5	7.5	7.5
T.O.C.	3	3	2
Conductivity	430	430	435

Wells No. 1, 3, and 5 are next to the Public Utilities Commission building. Well No. 4 is downtown.

MILVERTON - Sample collected July 4, 1974

	Well No.4	Distribution System	Well No.5
Hardness as Ca CO_3	190	198	200
Alkalinity as Ca CO_3	208	217	212
Iron (Fe)	0.85	0.35	1.1
Chloride, Cl	2.0	2.5	2.5
pH	7.8	7.8	7.6
Turbidity (formazin)	0.90	1.3	1.1
Calcium, Ca	48	52	56
Sulphate, SO_4	20	26	90
Fluoride, F	0.9	0.8	0.8
Magnesium, Mg	17	16	14

GROUND WATER ELEVATIONS

The static water elevations for the wells are listed. These are the depths below the ground surface at the wells. If need be these can be converted to mean sea level, and thus to show the relationships among the well waters at a recognized base. As examples in a well at Stratford the static level is listed as 49 and the elevation of the ground 1,192 above sea level, making the static water level 1,143 above sea level. These may be considered as approximate figures.

A well in Wallace Township at ground elevation shows 1,459 feet and a static water level of 32 feet, thus giving this water level as 1,427 feet above mean sea level.

Similarly a well at Milverton is listed as 1,265 feet, less 49 feet static water level for 1,219 water level in relation to mean sea level.

These elevations should show the slopes available for the ground water as it seeks its outlet to the sea; also some indications of the local formations in relation to the flow and storage of the ground water.

OBSERVATION WELLS

In Perth County, observation wells have been utilized at:

(1) No. 19 - At Stratford, depth 350 feet, 8 inch diameter, limestone aquifer - began 1946

(2) No. 44 - Blanshard Township by Fish Creek, 10 inch diameter depth 37.5 feet, gravel measuring point - started 1952.

(3) No. 45 - Blanshard Township - 4 inch diameter, depth 36 feet - in gravel.

(4) No. 51 - Fullarton Township - abandoned dug well, 36 inch diameter, depth 18 feet, sand-gravel aquifer.

(5) No.108 - Downie Township - drilled, 8 inch diameter, depth 75.5 feet, rock at 8.0 feet.

(6) No.182 - Stratford - 14 inch diameter, drilled 455 feet, rock surface at 127.5 feet.

Charts have been prepared from the records of these observation wells. The period covering this study is relatively short, but there is no indication of any downward trend. The levels vary from year to year, influenced by the rate of precipitation. This situation is supported further by the experience with other wells. These may cause difficulties in shallow wells, but the ground water reservoir has not been adversely affected, if the foregoing results represent the true condition.

POLLUTION STATUS OF WELL WATERS

In Perth County at present there is no indication of unnatural pollution in the waters of the deep wells. At the same time, the chemical analyses show substantial quantities of minerals picked up by the water as it travels from the surface into the wells. The geological formations, not only tend to this result but also to the seepage of pollutants through the crevices in the rocks. Hence, there is the necessity to protect these ground waters from surface pollutants.

The Public Health Act prohibits the use of abandoned wells for disposal of waste waters.

Deep wells for difficult waste disposal have not been used in the County. This is an attractive feature.

SUMMARY AND CONCLUSIONS

PERTH COUNTY WATER CONSERVATION

The following summary and conclusions are based on information secured from many sources, with related interpretations. The ground water resource in Perth County plays an important role in the development and forward march of events and human welfare.

(1) The records of wells, water resources, water quality and purification, and adequacy of supplies for the County's needs have been examined.

(2) Attention has been focused on municipal or public, industrial and private water supplies.

(3) Water has been and will continue to be all important to the welfare of the County's people.

(4) This is a County nourished principally by ground water rather than surface supplies. The latter are also important in many ways, such as for agriculture, recreation, and beauty.

(5) Five municipal water works systems serve a total population of 38,644. <u>All public systems are supplied by ground water</u>.

(6) The annual withdrawal of ground water for these public systems was 1.66 billion gallons. It may also be estimated that the total withdrawal of ground water in a year amounts to 2.36 billion gallons. The total annual precipitation over the County may be estimated at 3.671 billion gallons.

(7) In rural areas, no great difficulties are encountered in securing the water needs from deep wells. The mineral content has not always been acceptable.

Summary and Conclusions - continued

(8) The water from municipal wells, and also from others, was of good bacterial quality. A wise precaution is taken to use chlorination.

(9) The chemical constituents in the public supplies, as must be expected in such a geological formation, are somewhat high. Hardness is marked, but this has not induced municipalities to use softening. Iron is also higher than desirable for the best quality, and some action has been taken to reduce this. Likewise the total solids figures are higher than most criteria contain. Sulphate as SO_4 is correspondingly higher than desirable.

(10) The fluoride figures are mostly favorable at a recommended figure of 1 mg/l. The Stratford wells run as high as 2.2 mg/l. St. Marys is within the prescribed limits; Listowel is slightly low, as is also Milverton.

(11) There is no evidence as yet of man-made chemical pollution of the wells, but care needs to be taken to ensure that processes are not established where the underground supplies may be endangered.

(12) The geological formations underlying Perth call for two precautions, one against crevices which will permit surface pollution to reach the well water formations, and the other against the location of wells where the chemical composition of the water is high.

(13) Industrial water demands are likely to increase substantially. There appears to be a satisfactory supply for such uses, of good quality and low cost.

(14) The legislation controlling ground water in Perth is the same as that in most counties, largely provincial.

Summary and Conclusions - continued

(15) Conservation of ground water is essential. There is no justification for waste of this valuable resource. Measures need studying to obtain the most effective means for accomplishing this.

(16) Any doubt about the extensive use of ground water in Perth should be allayed by the recorded data, showing a total of 1,819 wells, only 56 being in categories of non-use, and 42 containing sulphur and minerals.

(17) The uses for which these wells are put are recorded as domestic or stock use 1,596 (88%), irrigation 20 (1%), industrial and commercial 87 (4.8%), public supplies 80 (4.4%).

DATE DUE

MOE/GRO/APHT
Berry, A.E.
Ground water in
southwestern Ontario   apht
A replenishable resource c.1   a aa

(16044)
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